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Evaluation Of Children's Usability Criteria

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Abstract

This master thesis explores usability in a system for children and the evaluation of their usability criteria. Many children experience that they cannot find the desired content or are not able to navigate from one section to another in software meant for children. One of the reasons for this could be that the software makes use of functionality that the children do not understand. To be able to design a system with good usability meant for children, they can be included into the design process.

The research done for this thesis have taken place at Senter For Pasientmedvirkning og Sykepleieforskning (SPS) at Rikshospitalet - Radiumhospitalet HF. SPS are in the process of making a symptom assessment tool for pediatric cancer patients, the PedsCHOICE project. Since the system is to obtain valid information from the children in the age of 7 to 12, it is important that this process goes as smoothly and intuitive as possible. To increase the possibility that the system will reflect the users understanding and needs, children were asked to participate in the project.

Children were included into the design process by conducting sessions. In these sessions, various participatory design tasks were given to the children for them to complete. The tasks included creation of paper prototypes, card sort and testing of various software. In the sessions the children were involved in various degrees. The participating children were never equal design partners to the adults in the PedsCHOICE project.

The research methods used for this thesis were a triangulation of qualitative and quantitative methods. To collect the data during the sessions observations and video recordings were used. Video analysis and categorization were used to analyses the data.

Many ideas were generated in the sessions that were conducted. The ideas from the videos were compared to usability criteria proposed by The Nielsen Norman Group and Hanna, classified into categorized and given a grade. This helped to evaluate whether an idea was usable or not. Depending on the grade, an idea was classified as consistent or inconsistent.

This thesis shows that half of the ideas that the children generated were consistent and usable. This study shows that there is a relationship between tasks given and the amount of ideas generated, some tasks created more ideas than others. Throughout most of the sessions, the children had to some degree difficulty to understand the purpose of the system. This could have been different if the children and the adults were equal design partners in this project.

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Introduction

In systems development, participatory design involves the future users of the system in the design of the system. This relationship between the system design and user's participation in the design process and the democratization of this process has been explored for more than twenty years in Scandinavia. It is an essential aspect and characteristic of the Scandinavian approach to systems development (Bratteteig 2004). In Norway, Sweden, and Denmark, user participation has traditionally been of strong importance and is used as a strategy for increasing working life democracy. Bjerknes and Bratteteig (1995) state two additional reasons for user participation in design. The first is to improve the knowledge upon which systems are built, for example, so system developers understand the work practice. Second, this process makes user adoption of the system easier.

In the Scandinavian approach, equality between system users and designers has traditionally been in focus, and this applies to child and adolescent users as well. Children's involvement can be included in many different ways, for example through observing them using a system, interviewing them following the use of a system, or by making them equal participants using participatory methods. Allison Druin and her colleagues' work make use of participatory methods that directly involve children as equal design partners with the adult designers. They have found that when children are asked to contribute in participatory design, children can provide feedback, ideas, and comments that add to the system design (Druin, 1999a). Their ideas can be expressed with the help of low-tech prototyping techniques, and are inspired by experiences with games, Internet use, the environment, and personal preferences.

When children provide ideas for a project, it can be a complicated task for developers to decide whether or not an idea should be used. Not all the children's ideas are good ideas according to guidelines: some do not follow the recommended usability criteria and other suggestions can be counter to the system's design criteria. Children may or may not have an intuitive sense of usability in the suggestions they have. They do not always have a good sense of what is feasible even though most children have a vivid imagination that leads to novel ideas for software development. According to Scaife and Rogers (1999), children have a tendency to focus on fun and entertaining aspects of the software. They also points out that it is difficult to select from children's suggested ideas and figure out which are feasible to

implement. Scaife and Rogers found that designers prefer implementing ideas involving additional sounds or animation because these ideas are regarded as add-ons and do not interfere with the original design or require lot of extra programming work. However, this does not necessarily make the software better to use, easier to find the desired content, or improve navigation.

Children are not a homogenous group, for example, between the ages of 7 to 12; there are differences in reading capabilities, understanding of words, expressions and the content.
Children express themselves differently regarding how they experience a system. They rarely use the word usability, but may instead say: “That was fun”, “I’m bored” or “Cool!”. Their reactions may be related to usability, when the usability is satisfactory the children may enjoy the content of a system. But if the usability is not optimal it will influence their user experience.

One aim for involving children in the design process is to make sure a system is easy to use for the children, for example by having understandable linking and navigation between various sections and features. If a system applies new ways to navigate or interact with the young users, the children may not be able to find a desired section or content. This may cause the children to be frustrated and impatient and may decide to leave the system. Even though intuitive sense may get the user a step closer to using the system, it will most likely not be enough. And that is why usability is important. When children have to use a great deal of time and resources to find certain information on the Internet or a CD-ROM, the usability is not optimal, and they may feel discouraged and disappointed when interacting with a system. Usability is important for all users, and not just for children. A system with good usability allows the user to concentrate on the content and not on how to find the content. Like Gilutz and Nielsen (2002) point out that usability and user experience research serve as the gateway to high quality content.

Aim And Research Questions

This project is done in the context of the development of a system called PedsCHOICE, which is a symptom assessment tool for pediatric cancer patients. Sessions with healthy children were conducted, during which they were given tasks to help design the system for sick children. The ideas they generated were captured on video, and analyzed after the sessions. The primary focus of this thesis is to determine whether children's suggested ideas are consistent with Gilutz and Nielsen's usability criteria for children (ibid) and guidelines proposed by Hanna and her researchers (1999). Comparing ideas with usability criteria is essential in order to evaluate participatory design methods using children and explore how many "usable" ideas children contribute during the sessions.

My aim for this thesis is to explore more about usability in a systems development project for children (PedsCHOICE) by examining the following research questions:

What are the types of ideas children generate in participatory design sessions?

a. In which participatory design tasks do children generate the most ideas

b. How many ideas fall into each usability criteria categories

- Are the ideas consistent or inconsistent with usability criteria guidelines?

- In which task do children generate the most ideas that are consistent with the usability guidelines?

- In which task do children generate the most ideas that are inconsistent with the usability guidelines?

- Are the consistent ideas incongruent with the project specification?

Delimitation And Structure

I limit this thesis to not include the handheld device for the system, privacy issues, encryption and safety issues, the pedagogical and psychological aspects of the system, technical architecture, high tech prototyping and design. I also so limit this thesis to not include procedures and expert opinions by clinicians.

The thesis is structured as follows; first an overview of the case will be given with participants and procedures. Then, the theoretical framework will be presented along with the methods. My results will be presented and discussed. And lastly, the conclusion and future research will be presented.

PedsCHOICE – Case Description and Procedures

In the recent years it has been an increasing focus on decision-making. When decisions are being made regarding their treatment, it is important to include the preferences of the patients. It is widely recognized that decisions on correct treatment from the perspective of the patient cannot be made without including the patient's own comprehension about their state of health (Ruland 2000). The project group at Senter For Pasientmedvirkning og Sykepleieforskning (SPS) [1] at Rikshospitalet - Radiumhospitalet HF [2], has developed different IT based computer based solutions within this field. **C**reating better **H**ealth **O**utcomes by **I**mproving **C**ommunication about **P**atients' **E**xpectations (CHOICE) and PedsCHOICE are examples of these solutions.

Figure 1: CHOICE, a symptom assessment tool for adult cancer patients, in use at a hospital setting (Annual report, 2004)

[1] Center for Shared Decision Making and Nursing Research
[2] Rikshospitalet – Radiumhospitalet Medical Center, Oslo, Norway

SPS has constructed CHOICE to improve the treatment by having the patients register their symptoms, rate their bothersomeness and register their priority for care, see Fig. 1. The system is used on a handheld device and is used by adults with cancer and in addition to the patient's medical journal. SPS wished to make a similar system for children with cancer in the ages of 7 to 12.

The purpose of PedsCHOICE is to offer the same as CHOICE, but adjusted to fit children who are sick with cancer. PedsCHOICE is hopefully going to help the children report their symptoms and problems. The intention is that clinicians can better adjust the treatment and nursing of the problem of each patient (Annual report, 2004). Like CHOICE, the PedsCHOICE system will be in addition to the patients' medical journals and will not replace a doctor or a nurse. Children with cancer experience complex physical, emotional and psychosocial symptoms and problems due to the illness, treatment, uncertain diagnosis and medical procedures (Ruland et al., 2005). The children will use the system to report their symptoms and bothers. This could not just be physiological bothers like nausea or headaches, but also psychosocial conditions like a child teased by peers or to what degree hair loss is perceived as a problem. The system will aid the clinicians to create individual plans for the treatment and nursing to children with cancer. Based on the patient's own perspective, the purpose is to achieve best possible treatment of the symptoms and level of function (Annual report, 2004).

PedsCHOICE will be designed for children in the age of 7 to 12, therefore it is important that the interface is adapted to children since they may communicate differently than adults. By using pictures or animations can make it easier for the children to express their problems and worries. One of the key elements of this project is that the structure of the interface must be easy to use so that the process of answering the questions goes as smoothly and intuitively as possible. A number of symptoms will be predefined in the system based on symptoms that children may have. These symptoms are adapted for children to make them more understandable. The system should be used independently of the children's reading- or writing abilities. This means, that the system cannot be based solely on text.

Participants

The study took place at the "Adolescent Club Room" at the pediatric department at the Rikshospitalet - Radiumhospitalet HF between May and June 2005. The purpose of the study was to explore what kind of ideas children could come up with that could contribute in the creative phase during the design process of the PedsCHOICE project. Given this focus, the researchers chose to conduct a pilot session and 9 additional sessions, divided between 3 different groups of children. All the groups conducted the same sessions. In total there were 16 healthy children of same ethnicity involved in the sessions: 12 school children and 4 children of hospital employees.

A local primary school was contacted and the principle gave permission to recruit children through the school. The teachers to all the fourth and six graders received a letter containing information about the project. In the letter, parents were asked if they were interested in being contacted by a project assistant to get more information about the project and possible participation. Parents were told to sign an informed consent and return it to the teacher if they were interested to have their children participating in the project. Those who were interested were contacted by phone to get the additional information. After permission was granted, the children were selected by the following criteria: participation level in group-activities, computer use, creativeness like drawing or building and motive for participating (Ruland et al 2005). The school children use a computer on daily and weekly basis for computer games, Microsoft Windows and the Internet (Vatne, 2005a). The children of hospital employees did not go through the same screening process.

12 of the children were from a local primary school in Oslo and consisted of two age groups, nine-year-olds and eleven-year-olds, with 6 children in each group. In the group of nine-year-olds, there were 4 girls and 2 boys, while the group of eleven year olds consisted of 3 girls and 3 boys. There were a total of 4 sessions for each age group [3]. The remaining 4 children consisted of children of hospital employees that were used for the pilot session and one additional session. These children were in the age of 8 to 10 and had the sessions together. The sessions for all the three groups were conducted on different days.

[3] The children who participated were given a gift certificate worth 500 NOK.

My aim is to explore usability in a systems development project, the PedsCHOICE project. Even though the system is meant for children with cancer, healthy children were used to contribute with ideas and suggestions. Both Bødker et al. (2004) and Druin (1999a) argue that by allowing the user to participate, it increases the possibility that the produced system will reflect the users needs and true situation. In this case there was a need for children's ideas and perspective, but children with cancer were not able to participate. Therefore the second best was to include healthy children in the project.

Procedures

Before the 12 school kids started with sessions, 4 additional children had a pilot session. All the sessions had an agenda and every overall major task was equivalent in time. During each session, adult observers and facilitators were present to either take notes or talk to the children. The number of adults present at the sessions varied. There were between five and eight adults present, including researchers, psychologist and cameraman at each session. All the sessions were recorded using two video cameras. Photographs were also taken. Each session lasted between 90 and 105 minutes. None of the ideas from adults are included in the data material. The children were told that the adults could help them if it was needed.

Pilot session

4 children participated in a pilot session and these were children of hospital employees, in the ages between 8 and 10, see Fig. 2. Their first session was identical to the other children's first session. The pilot children's second session was equivalent with the third session for the school children, namely the card sort. The pilot session was conducted so that the developers could receive initial feedback from the users and to figure out the best way to conduct a session.

Figure 2: Children making low tech prototypes during the pilot session. Two researchers sit with the children (Annual report, 2004).

Session 1

During the first session the nine-year-olds tried out computer games that SPS had selected for specific reasons such as variation in navigation, use of colors, degree of comprehension of the content etc. The children worked in pairs and were encouraged to think aloud. Some of the children found this more difficult than others, so the facilitator asked the children questions about their likes and dislikes regarding the computer games. For each pair there were assigned an adult observer who took notes and an adult facilitator who talked to the children, but did not take any notes.

After the games were explored, the children were told a story, a scenario, with the aim to help them understand the intention behind the system [4], see Appendix A. The scenario was followed by a creative phase where the children created their own suggestions to how the system could be, during which the researchers documented their work. The children were provided with low-tech prototype materials like colored sheets of paper, pencils, clay, clip art etc. There was no demand from SPS that the children had to work together in pairs. The

[4] The children were told a story about a child who was sick. The child was nauseas, had a headache and had trouble sleeping. The parents took the child to see a doctor. The parents and the doctor talked together and the child did not understand what they were talking about. The child wanted to tell the adults how s/he was feeling and was given a small computer and asked to tell it how s/he felt.

participant pool consisted of 4 girls and 2 boys. These children grouped themselves as follows: a group of 2 children; 1 girl and 1 boy, a group of 3 children; 2 girls and 1 boy and lastly 1 child, a girl, respectively.

The first session for the eleven-year-olds had the same procedures as the nine-year-olds. During the work with the paper prototypes there was also no demand from SPS to work in pairs for the eleven-year-olds. The children consisted of 3 girls and 3 boys. They grouped each other in a group of 3 girls and the rest worked individually.

To aid the understanding of what the participants had done, all the children presented his or her work to the rest and gave a summary of the work at the end of the session.

Session 2

During the second session, both nine and eleven-year-olds were given another scenario to help the children to understand the purpose of PedsCHOICE [5], see Appendix B. The children then continued to work on their suggestions. At the end of the session the children explained their design. Both the nine-year-old and the eleven-year-olds participated in this session.

Session 3

During the third session the children were asked to participate in a card sort. One of the facilitators read the cards out loud and all the children could read the cards themselves. They started to sort everyday words into categories, followed by sorting possible symptoms that a child may experience when sick with cancer. The children sorted the symptoms into categories while the researchers recorded the reasoning for the classification. All the 16 children participated in the card sort task.

[5] This time the children are told a story about a child who was at a climbing wall. The child started to climb the wall, but slipped and fell to the ground. After the fall the child had headaches and was nauseas. The child also had several bruises and a nosebleed. The child was sent to a hospital, but was afraid of what might happen there. S/he was scared and was not able to talk to the doctor. Maybe a small computer could the help the child to mediate to the doctor where it hurt and what was wrong.

Session 4

To the next session both the nine and eleven-year-olds tried CHOICE, the adult version of PedsCHOICE. Some of the children conducted this task while being in a hospital bed to create a more real life experience. The rest of the children observed by standing around the hospital bed taking notes or played a worried parent. The participants gave their opinion about CHOICE by reading their notes out load. Lastly the children commented on temporary illustrations for the project.

Project Specification

The purpose of PedsCHOICE is to help children with cancer in the ages of 7 to 12 to better communicate their symptoms to clinicians. With this setting, there are specifications that need to be considered. When I became a part of the PedsCHOICE project, many of the specifications for the project were already made. The system needs to be used on a hand held device that does not weight too much since the users are sick children. Since the children have intravenous inserted, the device has a touch screen and avoids the use of mouse. The navigation should be easy (Ruland et al., 2006). The children may also experience motor difficulties so the clickable items on the screen should be large (Slaughter et al., 2006). Since the users are in the ages of 7 to 12, not all of these children can read or write. This means that the system needs to support the children with both written and audio instructions, which implies that the questions and the grading of the answers should be easy to understand.

The symptoms should be easy to recognize and categorized. The categorization of symptoms in the system should not be too abstract since the children may have difficulty understanding abstract thinking (ibid). The symptoms needs to be grouped and displayed in such a way that the children understand where to go and what they are choosing. The system should not take too long; it is therefore necessary that the children have the possibility to skip irrelevant groups of symptoms (ibid). The pictures should also be easy to recognize (Ruland et al., 2006).

PedsCHOICE is not a game (ibid), hence the fun and entertaining aspects have been toned down due to the reason that the system should not ridicule the user with fun animation in

combination with very serious questions concerning their symptoms and emotions. Neither should it be too funny to use that the user intentionally gives the wrong answer. The pedagogical aspect with PedsCHOICE should involve normal things and have a narrator (ibid).

Theoretical Framework

The theories presented in this chapter will be the framework for the thesis. I will position the theoretical framework and perspectives in relation to my aim. Firstly, participatory design will be presented, followed the perspective of children as designers. Additionally, an overview of usability criteria for children will be given.

Participatory Design

One aspect in participatory design (PD) is user participation. The goals of user participation, as outlined by Bødker et al. (2004), is first that user participation increases the chances that a produced system will reflect the users' true situation and needs. Without their participation, the user does not, to the same degree, have the opportunity to make decisions that will influence the system. The second goal is that user participation increases the possibilities that the system will be used according to its intentions.

Another aspect of participatory design is mutual learning (Bratteteig, 2004). This means that users and designers learn from each other during the design process, and both qualify themselves with respect to the systems development process they are involved in (ibid). This is one element in the Scandinavian tradition of PD. In PD, user participation is important and to make it possible to accomplish, there is a need for mutual learning between the users and the developers. The most efficient way for developers to gain knowledge about the users' work environment on one hand and for users to gain knowledge about technical options on the other is by organizing activities. This will give the opportunity for both users and designers to learn from each other. A mutual learning process intends to create a shared understanding of the problems the new system is support to solve.

The ways a user may participate in a project may vary. Sometimes, users may be involved only as informants for the designers. The designers then analyze and present the results on their own (Bødker et al., 2004). If user participation is limited to users as informants, the systems may not cover the user needs. Examples of limited participation are interviews or system testing. Further, observation and think aloud are useful techniques to gather first hand

experience of work practices and use of systems. Workshops are useful when the project group needs to develop an understanding of the users' current work or when developing sketches of future IT usage (Bødker et al., 2004). The experience of Bødker et al. (ibid) found that users could contribute with innovative and constructive suggestions.

The assumption behind the PD approach is that users and designers can view each other as equals. Is the same true when the users are children and given the same responsibility as the adults? Or is it more responsible to assign the children more traditional roles and acquire their opinion on their likes and dislikes about a prototype? Scaife and Rogers (1999) have discussed this in their research. Children are very good at expressing what motivates them in a learning context but has a tendency to exaggerate when it comes to saying what they find boring.

To involve children in a systems development project can help the developers to understand and to get new perspectives on what the children like or find appealing to use with a system. My aim for the thesis is to explore usability in a systems development project. The children's contribution to the PedsCHOICE project has given me an opportunity to do this. Druin and her colleagues have a broad experience with involving children in the design process. Projects that have been successfully designed with their methods include educational software, entertainment software and a digital library for children (Druin, 1999a, Druin et al., 2003).

Children As Designers?

The general impression is that children are too difficult to involve in projects and that it takes a lot of time and recourses to involve children in the design process (Hanna et al., 1999). Or that it's not necessary for a given project to include children because the developers feel that the user is satisfied with animations and sounds. Libby Hanna and her colleagues' research indicate that there is a close relationship between usability and enjoyment of a system. The Microsoft usability engineers have been working with products for children for many years. Recently, usability was added to the formal standard practice during product design. The Microsoft Kids product team considered that children's involvement was just as important as usability. Some projects were abandoned during the development phase due to the difficulty to evaluate product ideas for "fun". The usability engineers were able to define some

components of a fun product through literature review, surveys and response tackling over product generations. The children's response included words as "familiarity", "control" and "challenge" and most importantly this illustrated that ease of use is crucial to the engagement aspect and for the success of the product.

Roles Of Children

Children have their own likes, dislikes, curiosities and needs that are not the same as their parent's or teacher's. Designers of new technology for children can sometimes forget that young people are not "just short adults". The children have their own culture, norms, and complexities (Druin, 1999c). By understanding the role that children have in the technology design process, it may help to create better understanding of the children as users on one hand. And can better serve their needs on the other hand. In her work with children, Druin has come up with four main roles that children can have in the technology design process: user, tester, informant, and design partner (ibid).

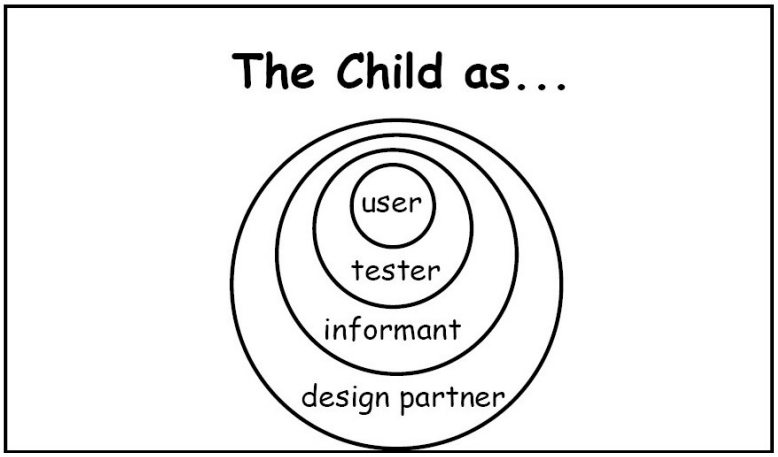


Figure 3: Illustration of various roles a child can have in the design process. The roles are user, tester, informant, and design partner (Druin, 1999c).

In the role of *user*, the child is observed while using technology, during which the researchers observe, videotape or test for skills, see Fig. 3. A child in the role of *tester* involves testing of prototypes that has not been released by researchers yet. And the child is asked questions about its experience of using the technology. An *informant*, in this setting, means that the child participates in various stages of the design process based on when the researcher believe

the child can inform or add something new to the design process (Druin, 1999a) [6]. In the role of *design partner*, the child is considered an equal stakeholder in the design of new technologies throughout the entire experience (Druin, 1999c). Druin's young design partners where also a co decision maker concerning which ideas to use further in the design process (Guha et al., 2005) [7].

Through her research, Druin has found that children in the ages 7 to 10 are the most effective design partners (Druin, 1999a). Children in this age are self-reflective and verbal enough to discuss their thoughts. They are also not preconceived of how things "are supposed to be". According to Scaife and Rogers (1999), when children are involved in the design process it is effective to have the children work in pairs. This stimulates interaction. Druin's findings also show that a single child in productive in a collaborative design setting (Druin, 1999a). Hanna et al. (1997) discusses the involvement of using your own or colleague's children as usability participants. According them, it is in general doubtful to include these children in projects. They argue that children may have above-average exposure to the products their parents work with.

Jacob Nielsen and Allison Druin have different opinions regarding children as design partners. Druin applies a child-oriented approach to design and argues for including them in the design process since the children have a lot to offer (Nesset and Large, 2004). Nielsen agrees about respecting the needs of children as expressed by children, in the context of the Internet (Nielsen, 2002 in Nesset and Large, 2004). He argues that many of the websites take it for granted that the children can overcome any obstacle when using a computer. As a result of this, some of the websites for children are too complex. But children can use adult websites that are simple and comply with usability principles. Based on this, Nielsen agrees with Druin about involvement of children in the design process (Nesset and Large, 2004). The difference between Nielsen and Druin is that Nielsen found that the children are not able to overcome the usability problems. The children seem impatient and when meeting complex features have a tendency to leave the system. Nielsen argues that this impatience prevents the children to critique websites for usability issues and therefore cannot make suggestions for improvement. This is much more relevant in the Web environment than in a software development (ibid).

[6] This approach was used during the External Cognition for Designing and Engineering Interactivity (ECOi) project – a project to make children learn basic ecology, especially food webs (Scaife and Rogers, 1999)
[7] During the StoryRoom project, an interactive storytelling for children, the children were in partnership with the adult researchers and worked together during the design process (Alborzi et al., 2000).

But Druin is aware of at least one difficulty of including children in the design process. And this is the children's ability to verbalize their thoughts, especially when dealing with abstract concepts (Druin, 2002 in Nesset and Large, 2004).

In addition to focusing on children's various functions in the design process, Druin also applies research techniques for analyzing user and task and lastly designing a product. This will be presented in the following section.

Usability - Research Techniques

Three basic processes were used when Hanna's research group conducted usability research. The first is to *analyze the user*. This involves to understand the user' skills, knowledge and expectations. When analyzing the children for a product, the researchers can start with an age range and provide information about the users within that age group. The second process is to *analyze the task* to understand the user activities that software is intended to support. The last process is to *design a product* in the iterative phases based on the analysis of the user and their tasks. This puts the previous two steps into the actual design process (Hanna et al., 1999).

To be able to understand the user or to analyze the task, several methods can be used. One of them is *expert reviews*. Expert reviews provide "quick checks" on design to catch obvious problems (ibid). Another technique is *site visits,* which provides information about children's use of products in the context (ibid). Before starting the design for a system, *observation*s or looking at the work environment can reveal aspects for improvement, like productivity or efficiency (see also Bødker et al., 2004). Hanna also used *surveys*, where the children were asked to rate certain system features, and she adopted them according to age.

Classification is something humans do in their everyday lives. We sort dirty dishes from clean, white laundry from colorfast, important e-mails from e-junk. Any part of the home, school or workplace reveals some system of classification (Bowker and Star, 2000). Hence categories are not neutral. They reflect a point of view or a perspective of the people who made the categories. There have been numerous examples through the years like cultures, NTCS vs. PAL format for DVDs, age limit for moviegoers or folders on a desktop. Each

example tells something about where or why they originated. Even if you are using categories, the researcher's aim influences what kind of categories that may emerge. When you sort things in, you need to be aware of what you sort out. This intuitive classification and sorting are used in *card sort*. This is a technique that can be used early in the development process. The purpose behind card sort is to ask the children to sort certain cards into predetermined categories or to make new ones and children as young as eight-years-old can participate in a card sort. This technique can be used to test how well the given categories fit children's expectation. A word-processing program for children, Creative Writer, used this approach to ensure that the categories were in accordance with the children's expectations (Hanna et al., 1999).

Paper prototypes, or mock-ups, can be tested with children. Screen shots, sketches or storyboards can be put together and illustrated to the children. By pointing at objects, they can recreate a mouse click. To compensate for a new screen after clicking on an item, the researcher can turn the pages. This help to predict errors that children can make when using a system in the future. Scholastic's The Magic School Bus Explores in the Age of Dinosaurs, a science exploration program, were tested by Hanna et al. (ibid) at Microsoft, by using drawings during the preliminary designs. When dealing with paper prototypes, Scaife et al. (1997) found out that when the users, including children, are presented with a piece of software to evaluate, they are constrained to make suggestions at a lower level. Wong (1992 in Scaife et al., 1997) found in general that when users were presented with the interface as rough sketches, this drew out more feedback from the users than finished interfaces. Sketches prevented the users of getting too fixated on low-level issues. This could, for example be as what size a button should have rather than if buttons are appropriate.

Lastly, Hanna and her researchers also used traditional laboratory usability tests. They utilized a mirror that team members stood behind to record behavior and computer screen capture. The children participating in the usability tests did not see the team members behind the mirror. This technique can be used iteratively as the product is designed. Functionality in a system can be tested, modified and then tested again. A project that used this technique was animatronic doll Actimates Interactive Barney. This was a peek-a-boo game, and it was repeatedly tested to make certain that it acted in response to children's expectations (Hanna et al., 1999).

After the user, the task and the product to be design are analyzed, it is important to understand what is needed in the development phase of a new product. One of those needs is to involve the user in the design process. Druin have produced a research approach adapted to children as both design partners and end user. This will be presented in the following section.

Design With And For Children Methodologies

A research approach for designing with and for children is called *cooperative inquiry*. A part from child involvement, the approach is grounded in human-computer interaction (HCI) research and theories of cooperative design, participatory design, contextual inquiry, activity theory, and situated action (Druin, 1999b).

The cooperative inquiry includes three aspects. First aspect is the creation of a multidisciplinary partnership with children. Cooperative inquiry is based upon the belief that partnering with users is an important way to understand what is needed in developing new technologies. (ibid). Second, field research that emphasizes the understanding of context, activities, and artifacts. Cooperative inquiry is also grounded in the traditions of field research. A great deal of information can be quickly understood about the needs of users from the activities and artifacts that are a part of a user's context. Contextual design, activity theory and situated action all discuss the importance of these crucial elements in researching end development (ibid). The last aspect involves iterative low-tech and high-tech prototyping. Children may have a difficult time communicating to adults exactly what they are imagining, prototypes offers a concrete way to discuss ideas (ibid). During the KidPad project, a storyboard software [8], this methodology was used. Druin and her researcher took into account what the research had told them and developed a tool that enabled children to express themselves. KidPad enabled children to tell stories by, for example, drawing (Druin, 1999a).

Each time designers make decisions in the design process; it will affect the end users. If children use the products, it can affect how they learn or play. If the children are to learn while using a system, they should be able to achieve their goals in an efficient and satisfactory manner. But this is dependent on the choices made by the designers. Usability is an important part the first impression of a system and a contributing part of the continuous use of it.

[8] KidPad was developed at the University New Mexico, New York University, and the University of Maryland

Usability Criteria For Children

A computer system can help you to complete a desired task smoothly or it may make you frustrated if you are not able to accomplish the task in a satisfactory manner. Computer users of all ages may have experienced both scenarios. When the usability is good, it goes unnoticed by the user. The user can then concentrate on completing the task. When the usability is not optimal, the user has to use time and recourses to understand how to perform a desired task. If a system is difficult or confusing to use, the users will not use it. If software fails to clearly state what it offers, the users will leave. If an IT system does not let the user find desired information, the users will abandon the system. The users can go great lengths to avoid using systems that are complicated to use.

Usability is widely seen as the answer to many of these frustrating interactions with technology (Maurer, 2004). According to Maurer, usability is an umbrella term that covers two related concepts; first, usability as an attribute of quality of a system and second the process or set of techniques used during a design and development project. The latter may be described as usability engineering or user-center design. For the quality aspect of the usability, there are various definitions. One of them is the ISO 9241-11: “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ibid). This definition may include both adults and children as users. The definition involves four elements. First, the system has specific users. Second, the users have specified goals. Third, the system should allow the user goals to be met (effectively) in an efficient manner. And fourth, the users will be satisfied with the process or outcome and system will be used in a specific context. A usable system is one that is designed to consider all of these elements (ibid). There are other competing definitions of usability such as the ability of the user to easily and intuitively understand and then navigate through the components of an interface (Nesset and Large, 2004). Nielsen identifies five attributes of usable interface (ibid); first, it is easy to learn, second it is efficient to use, third it is easy to remember, fourth it causes few errors and fifth it is pleasant to use.

The children have usually most experiences from computer games, educational games, CD-ROMs etc. Fisch (2004) found out that usability in interactive media is essential. The

navigation icons must be clear, consistent and intuitive. In computer games, user's experience is the basis for the design (Swartout and van Lent, 2003). The use of interactive media, such as computer games and educational games, is voluntary and therefore it is central that the usability aspects of the software do not affect the use. Otherwise children are not attracted to use the software (Fisch, 2004). According to Fisch (2004), children are attracted to use software that gave visual action, appealing characters that they can identify with and music and sounds have been used to capture children's attention.

Usability checklists and guidelines can be useful to provide ideas about usability issues, but they must be assessed to determine whether they are relevant to the user and context (Maurer, 2004). Both the guidelines of the Nielsen Norman Group (2002) and Hanna (1999) involve children and are therefore very relevant for my thesis. The guidelines are concentrated around children's usability criteria. The guidelines of the Nielsen group are very specific and detailed. In comparison to these guidelines, Hanna's recommendations are more general.

Guidelines For Designing For Children

In the past several years, a number of researchers have examined usability criteria for children's applications. Gilutz and Nielsen (2002) have looked at various kinds of user experiences on the web and uncovered similarities and differences between the reactions of children and adults. In their study, 60 children from Israel and the USA, ages 5 to 11, were observed while using 27 different websites. Of these websites, 24 were designed for children and 3 were mainstream websites designed for use by adults. They concluded that many websites' design criteria are based on "folklore" about children's behavior such as they are masters of new technology and that they can defeat any difficulties when using computers.

The guidelines proposed by the Nielsen Norman Group were the result of the biggest conducted study, as of 2002, concerning children's interactivity with websites (Nicol, 2003). The guidelines have gotten broad press coverage. BBC, CBS News, New York Times, Wall Street Journal, ClickZ and .Net have all published parts of the study. NASA Education has kept up with the research concerning children's usability and the use of the Internet and posted the guidelines in an internal NASA web page, the NASA Learning Technologies (NASA, 2002). The Nielsen Norman project group wanted children's user experiences in general, so the tested websites had a broad variety with one common theme – websites that

included games and activities for children with many different implementation methods like multimedia, text, highly interactive features etc. (Gilutz and Nielsen, 2002).

The guidelines of Gilutz and Nielsen fall into the following groupings; general interaction, text, multimedia, navigation and search, graphical user interface, system errors and help and content [9]. Here I will present the Nielsen guidelines and relate them to the guidelines proposed by Hanna and her colleagues.

General Interaction

The first category, *general interactions* includes general aspects with a web site and the use of Internet such as domain names, standardized forms, members-only features and privacy (Gilutz and Nielsen, 2002). Further it covers common interaction like principles of good design, scrolling, standard interaction schemes, explicit directions and use of icons. Hanna (1999) recommends that icons needs to be visually meaningful to children in that sense that the icons are easily recognizable, familiar and represent items in the children's everyday world. Hanna's guidelines coincide with Nielsen and his researchers recommendations.

Text

Text, the next group of guidelines recommended by the Nielsen Norman Group contains suggestions when dealing with text like fonts, positioning of text and animated text (Gilutz and Nielsen, 2002). It also includes other aspects of text like readability level, adult sections, textual instructions and supplementing text with other kinds of explanation. Hanna (1999) also has elements in her guidelines that involve text. A guideline concerning text proposed by her is that text should be avoided if the users are very young children. Further, the language for the program needs to be simple. These guidelines can be recapitulated with Nielsen's guidelines concerning text.

Multimedia

Suggestions from the Nielsen Norman Group concerning *multimedia* covers guidelines in regards to specific Internet needs like connection speed, downloads and flash replays (Gilutz and Nielsen, 2002). But also contains more general aspects of multimedia like motion and sound, control of multimedia clips, intro animations, non-multimedia content and background

[9] See Appendix D for the guidelines by Nielsen Norman Group

music. Further it involves visible audio, popular music, sound to enhance interaction, rollovers for narration and navigation independent of audio. In her guidelines, Hanna (1999) proposes recommendations in relation to multimedia. The control of the interface should be given to the child. This allows the user to determine the pace of the interaction and animations and audio commentaries should be stopped or skipped if found necessary by the children. Further, Hanna suggests that the children can have the text read out loud, if desired. Characters in the system should not distract the children by constant talk or animation. Lastly, hotspots and rollovers can assist the children to find clickable items. These guidelines are reflected in the guidelines of the Nielsen Norman Group.

Navigation And Search

The group of *navigation and search* proposed by Nielsen and his researchers contains recommendations for navigations such as use of standards, category names, navigation levels, interface elements, feedback to user and standard navigation tool (Gilutz and Nielsen, 2002). Suggestions for search include constant access to search feature and search results. For navigation, Hanna (1999) also has recommendations like each step of the program should be easy to remember. If the children are required to indicate when a task is finished, a logical sequence like opening a gate, should be used. Hanna's suggestions coincide with the recommendations of Nielsen and his researchers.

Graphical User Interface

The Nielsen Norman Group's suggestions regarding *graphical user interface* covers breadth of content on start page, precise labels, clickable items, visual rollovers, pushable text buttons, promotional elements, advertisements and exits (Gilutz and Nielsen, 2002). Hanna recommends that icons should be three-dimensional to enhance that they look clickable. This corresponds with guidelines proposed by Gilutz and Nielsen.

System Errors

The next group recommendations by the Nielsen Norman Group is *system errors and help* which covers help sections, potential technical errors, terms, user settings, dialog boxes, accommodation of low-tech audience, and plug-ins (ibid).

Content

The last group of suggestions by Nielsen and his colleagues, *content*, contains user interests, user's age, stimulating content, current content and characters (ibid). Hanna (1999) has recommendation concerning content such as control over the interface. Further, Hanna suggests for the young children that everyday scenarios like drawing and coloring, dress-up and action figure and doll play can create the best interactivity. Moreover she emphasizes age appropriate instructions. Characters should be supportive and not distracting. The character's comments needs to reflect the task done by the user together with perfect timing. The character can give instruction to the user. Hanna guidelines coincide with Nielsen's recommendations.

In addition to the guidelines proposed by the Nielsen Norman Group, Hanna (ibid) recommends that activities should be designed increasing complexity and support children as they move from one level to the next in use of the product. The other guideline suggests that to maintain the use of a product, motivation is important for the user.

Methods

This chapter begins with a short presentation of my fieldwork. This will be followed by a brief overview of qualitative and quantitative methods. Then the methods used in this thesis will be described such as observation, video (recordings and analysis) together with how the data has been analyzed.

In January 2005 I started my fieldwork in the PedsCHOICE project. My involvement was first through a course at the University of Oslo. During that time I participated in half of the sessions conducted with the children. When I became a part of the project, a lot of the project criteria were already set. They had decided to conduct session with children to get ideas from their suggestions, to have a graphical designer make prototypes, to have the recordings from the sessions analyzed, various decisions regarding the content, design process and design issues to name a few. Additional, through a literature review and expert opinions from clinicians, SPS made a list of symptoms that the children with cancer were likely to have.

Qualitative And Quantitative Research

There are two main methods for data collection, quantitative and qualitative methods. Quantitative research methods include interpretive studies like surveys and experiments. Examples of qualitative research are observations, interviews and video recordings. The choice of the research methods depends on the aim of the research and the most relevant methods for the study should be chosen. In this thesis, I have applied both methods due to my aim and research questions and used observations and video recordings from the sessions, together with occurrences of ideas and categorizations.

Qualitative data usually consists of words and observations. The collected data is required to be analyzed and interpreted to bring order and understanding (Taylor-Powell and Renner, 2003). The process for the analysis is not rigid, but fluent. The understanding of the data is important to be able to do an analysis. Texts, audio and video recordings need to be reviewed several times. Even though data is captured, does not mean that all of it is quality data. The recorded data may contain information that is not relevant to the area of interest.

Quantitative data typically consists of numbers and quantitative research covers a range of techniques that can be used to quantify such as categories, evaluations, options and attitudes that potential users may bring with them. The statistical analysis or numerical data created when using quantitative research can be generated when using quantitative methods (Peterson, 2004).

In some cases quantitative and qualitative research can be incorporated into the same study by collecting and analyzing both forms of data. This is done by combining observations and interviews (qualitative data) with traditional surveys (qualitative data) (Creswell, 2003). The methods for collecting data may have limitations. Triangulating is a mean for seeking convergence across qualitative and quantitative methods (ibid). The result from one method can develop or inform the other method. Within the mixed methods approach, there are different variations.

I used qualitative methods for the data collection through observations and video analysis. These methods were applied to capture the children's ideas and gave the possibility of reviewing the material as many times as desired. The quantitative methods were used on the collected data material to be able to compare and classify the ideas. The methods I have used will be presented in the following section.

Observations And Video Recordings

In the PedsCHOICE project observations were conducted. This is one of the methods in qualitative research. This method has long traditions in qualitative research, like the pioneering case studies of non-Western societies by early anthropologist (Silverman, 2001).

The reason for conducting observations is to be able to explore more about usability. And by conducting observations while the children are involved in certain tasks, reveals how they behave and what they say and comment on. Any kind of observation involves examining certain activities as they unfold sequentially over time (Sanderson and Fisher, 1994). Usually observing means that the researchers do not attempt to contact the individuals being observed. The reason for this is that the researchers want to get a firsthand impression of what really happens, as opposed what the individuals think they do.

The observations conducted in the PedsCHOICE project were to understand and to get a perspective of how the children perceived certain software and low-tech prototypes. Throughout the sessions, between 4 and 6 children were present along with adults who observed and took notes. These observations were carried out at the adolescent clubroom at the hospital [10]. Video technology was another method used in PedsCHOICE to collect data. The video recorders were set up in the adolescent clubroom at the hospital. One video camera recorded from a fixed position while one of the adults recorded with a handheld camera for close-ups.

During the sessions, I was an observer, and sat next to the children taking notes while they performed various tasks. In Druin's work, both children and adults took notes during a session with children (Druin, 1999b). This was done to break down the "school scenario" that the children might have felt and thought that they were being tested for right and wrong answers every time they did or said something. During the note taking, there was one facilitator, usually a child who initiated discussions, and note takers who did not have conversations with the child being observed. The children usually took notes making cartoon like drawings.

Data Analysis

To be able to process the collected data, analysis is necessary. In the following section my analysis for this thesis will be presented. I classified the data from the video analysis into categories in two phases. This will be described in the following section. Categorization is an iterative process. During the process, the categories may change. The categories might be adjusted if the definition is too wide or too narrow. Some data may not fit into the existing categories and new ones have to be created.

Classification And Coding

Coding of the categories can be done in several ways. One way is called preset categories (Taylor-Powell and Renner, 2003). This means that the researcher starts with a list of pre-defined categories that may occur and then searches the data for these occurrences. The

[10] See page 8 for a more detailed description of the procedure and sessions

researcher starts with concepts of interest or topics from literature. A pre-defined list gives directions for what to look for in the data. The themes are identified before the categorization of the data in this technique.

The Categorization

The categorization was conducted in two phases. During the first phase in May and June 2005, a fellow master student and myself started to extract the ideas from the sessions that were captured on film. The purpose of the video analysis was to extract the children's suggestions and be able to use some of these ideas as the first phase in the design for SPS. We watched 22 hours of film, during which we documented the children's ideas.

I have in this thesis looked at ideas as comments, feedback, low-tech prototypes and suggestions made by the children during the sessions. All ideas are considered equal, i.e. there is no distinction between ideas that were created in the spur of a moment and ideas that the children worked on for a longer period of time. Every time a child made a comment, feedback or a though during the sessions [11], it was classified as an idea and registered [12]. Only the children's ideas were documented. Every idea was assigned to a category. The written notes from the sessions were used as help if the quality of the video footage was not in satisfactory.

As the continued work on the material proceeded, the list of categories emerged as a result of several conversations and discussions. The categories were divided into sub categories and sub 2 categories, depending on how many occurrences of ideas there were in one category. The children's suggestions could fit into more than one category. These ideas were classified into sub or sub 2 categories. This meant that one idea occurred more than once, and coded into several categories, but an idea remained unique within each sub category. The reason for this was that we were unwilling to omit one idea on the behalf of another. The categorization was based on a predefined list of nine categories, see Appendix C. The list was created by one of the researchers in the PedsCHOICE project.

During the second phase of the analysis, my focus was usability. I created categories that were based on the existing ones from phase one, and supplemented with key elements of

[11] See page 8 for a description of the sessions
[12] The ideas were first registered into a Word document and later redone as an Excel document.

Gilutz and Nielsen's usability guidelines. In total I created seven main categories. Just like in phase one of the categorization, the categories were divided into sub categories and sub 2 categories for the second phase as well, depending on how many occurrences of ideas there were in one category.

All the discussed guidelines by Nielsen and his colleagues contain recommendations when dealing with certain features concerning usability. Theses recommendations gives both advantages and disadvantages. These recommendations were the basis for the comparison of the ideas the children generated. If an idea were a full match compared with the Nielsen Norman Group guidelines, it was given the grade 2. If an idea had a partial match compared with the guidelines, it was given the grade 1. And lastly, if an idea did not match the guidelines at all, it was given the grade 0. To sum up, the grading scale of comparison of the Nielsen guidelines went from 2 to 0, with 2 = full match, 1 = maybe and 0 = no match.

The grading 2, 1 and 0 is illustrated with three examples. An idea classified with grading 2 was suggested by an eleven-year-old girl, she said: "*you can click on the character that you like the most and choose its appearance*". This comment was made when the girl explained the choice of avatar. The user could pick from various avatars and choose the one that seemed appealing to the user. The eleven-year-old girls comment is compared with guideline number 68, which recommends, "*Design characters that kids can identify with. Kids are attracted to characters in general, especially when they are popular and funny*" [13]. The girls' idea was evaluated as full match since she could identify with the character, which attracted her.

An eleven-year-old girl suggested an idea classified as grading 1: "*we have this help button that will take the user to a help page with text*". This idea goes partially counter with 2 guidelines. The first guideline is number 54, which suggests, "*Integrate Help with the content. Most user assistance should be included in the main content of the page. Do not rely only on a separate Help section to inform users*". The second guideline is number 21: "*Help inexperienced readers by supplementing text with other kinds of explanation*". According to Nielsen's guidelines help should be easy to find and accessible. But help should be integrated in the content and not dependent on a separate help section. Help should also not just rely on text, but also through other media like animation and sound. The eleven-year-old girl's idea

[13] See Appendix D for references for the guidelines by The Nielsen Norman Group

was evaluated as a partial match since the idea contained some elements that were consistent with the guidelines, but was not a full match.

One of the nine-year-old girls suggested an idea that was classified with grading 0: "*you can scroll if you want more space*". This idea is compared to guideline number 3, which recommends, "*Design for no scrolling. Fit information on a page viewed at 800 x 600 resolution*". The guidelines recommend that there should not be designed for any scrolling, since children scroll rarely use this feature. Therefore, the idea did not match the guideline since the girl suggested scrolling. The process of comparing the ideas generated by the children with the proposed guidelines by the Nielsen Norman Group (2002) and Hanna (1999) was repeated and all the ideas were given a grade. This was done after all the children's ideas were classified into categories.

By having the ideas graded made it possible to evaluate how useable the ideas the children created were in general on one hand. And how usable the children's ideas were for this particular project on the other hand. All of the ideas were not graded due to the fact that some ideas were more preferences and did not contribute to my thesis such as personal opinions or preferences like opinions regarding nausea as a feeling and one child thought that "*it was stupid that it wasn't any fun*" to test CHOICE.

Not all of the 70 guidelines proposed by the Nielsen Norman Group are relevant for my thesis, since they originated from the study of children's use of websites. They contain criteria that deal with aspects that are closely related to the Internet, like domain names, banner adds, plug-ins, connection speed, downloads etc. My aim with this thesis is to explore usability and especially in the systems development project PedsCHOICE. My research questions are focused around usability, categorization and children. The guidelines are relevant to both my aim and research questions. However only the guidelines that are essential for usability and design will be used. Many websites are colorful, interactive and appeals to children. The websites that were used for the exploratory study have features in common with the PedsCHOICE: both have various multimedia, text and interactive features, the navigation is similar between the two, the users are in the same age group and the two applications should be engaging and easy to use. A key aspect with the guidelines is that they address usability for children. And that is two crucial parts of PedsCHOICE: usability and children. If PedsCHOICE's interface and design is not sufficient, the usability will suffer. Every guideline

is analyzed and discussed by the Nielsen Norman Group and gives an indication of what children expect when using a website. This aids the understanding of how to proceed when designing PedsCHOICE.

Reflections on Method

The methods I used were predetermined by the SPS when I became a part of the of the PedsCHOICE project. The decision to conduct session had already been made. Consequently, this meant that the methods for my thesis was also decided and would include observations, video analysis, and categorization of the ideas suggested by the children. I did not decide how the sessions were to be conducted, where it was carried out, the tasks given or who was involved.

The number of adult present at each session varied. The number of adults present at the session was too many to what Druin recommends (1999a). At the adolescent clubroom the number of adults was between five and eight, thus sometimes there were more adults than children present. The amount of the adults became regulated after the first session for the nine-year-olds and for the remaining sessions, but in my opinion there were still too many adults present even after the regulation.

Experiences of Jordan and Henderson (1995) show that adults may adapt to the camera quickly. Druin, however, did not find video cameras to be successful when working with children (Druin, 1999a, Druin, 1999b). The children became uncomfortable with the camera and tended to perform in front of it as if they were “on stage“. Throughout every conducted session, two cameras recorded the children, one in a fixed position, the other a handheld camera. When a camera is used for data collection, there is a possibility that the participants may be influenced by the presence of the camera. In any case where the participants feel that they are being observed or tested in some way, persons may change their behavior or avoid showing their face to the camera. The children participating in the PedsCHOICE project never did perform in front of the camera. But during the first sessions for every age group, the children were quiet and behaved very nicely. There is a possibility that they were affected by the cameras recording everything they said and did in combination of too many adults present

and that they did not know them. In addition adults sat next to them and took notes whenever they said or did something.

One nine-year-old girl was very shy and quiet throughout all the sessions. The camera, the adults and the situation could have been a contributing factor for this behavior. The children's behavior improved as the sessions went on and they got used to the camera. It became just another "thing" in the room after a while (Jordan and Henderson, 1995). After the second session the children didn't seem to mind the camera and concentrated on solving the tasks given to them. There is a possibility that they would have behaved without a camera. I think that video recordings were the best way to capture the children in action. Some of the recording did not have a satisfactory audio quality. And sometimes it was difficult to try to hear what a child said when four or more children were talking at the same time.

During her work with digital libraries, however, Druin videotaped the children (Druin et al., 2003). The study was detailed with statistics and quotes from the children. This gives the impression that if the researchers are interested in detailed results, like statistics and quotes, as was the case for the digital libraries, then videotaping is an acceptable method for collecting data. The digital library study did not, however, discuss how the children behaved in the presence of the camera and if it affected the children.

The data collection and analysis for this thesis was a triangulation of variety of methods. The combination of quantitative and qualitative gave me the opportunity to compare the result from the quantitative and qualitative methods. The study started with qualitative methods and data, then qualitative methods were used to increase the understanding of the data material. This study had a qualitative collection of data and a quantitative analysis of the same data. The analysis also had elements of qualitative analysis by references of ideas and quotes from children and not just numbers of ideas that occurred. The qualitative data were quantified and the ideas have been classified into certain categories. The occurrences of the ideas in each category have been given.

Ethical Aspects

Ethical aspects in relation to the methods are focused around the use of video camera. The children are recorded with a camera that is in plain sight and not hidden behind a one-way mirror. If the children where observed through a one-way mirror and recorded by a camera, the children may have behaved more naturally, and reflect their true reactions. But this way of observing has ethical concerns regarding collection of data that normally would have been private and possibly not voluntary revealed to a researcher. Recording through a one-way mirror is less ethical than having the camera in plain sight.

The 16 children were aware that they were video taped. The parents have given their consent for recording them. The children contributing in my thesis have remained anonymous to protect their privacy.

Results

In this chapter I will present the results from my analysis of the videos. First, the ISO definition is applied to this project. Then the various types of ideas will be presented along with the task that generated the most ideas. Further, usability criteria categories with consistent and inconsistent ideas compared to Nielsen and Hanna's usability criteria together with consistency and inconsistency by task will be reviewed. Lastly, ideas that were consistent with the usability criteria proposed by the Nielsen Norman Group (2002) and Hanna (1999) but were inconsistent with the PedsCHOICE specifications will be presented. The results, which reflect my aim of exploring usability, will be illustrated in various tables along with pictures of the children's work from the sessions.

The ISO definition of usability in the theoretical framework includes four elements according to Maurer (2004). These four elements have been applied to the PedsCHOICE project and here are the results. First, the system has specific users and in this project the specific users are children with cancer. The second element is that the users have specified goals. The goal for the children when using the device is to report their symptoms in the best possible way so that the clinicians can give them a more adjusted treatment. Thirdly, the system should allow the user's goals to be met (effectively) in an efficient manner and the users will be satisfied with the process or outcome. The children will hopefully be able to report their symptoms in an efficient manner and be satisfied with process by using the device. Lastly, the system will be used in a specific context, which is for the PedsCHOICE project the hospital.

Ideas Suggested By The Children

During the sessions, the children were given different tasks. The first and second session involved drawing and creating their own version of the system. The third session involved a card sort task where the children were first asked to sort everyday words then symptoms. During the last session the children tried CHOICE, the symptom assessment tool for adult cancer patients, by answering questions and rating symptoms when the system requested it. They also commented on a low-tech prototype for the PedsCHOICE project.

In the sessions, the children created many ideas. Their work in the first two sessions resembled common metaphors. Some of the nine and eleven-year-olds were inspired by Microsoft Windows and made their systems almost identical to existing Windows applications like Paint. The buttons and features are the same, see Fig. 4.

The only difference is the background, which the girl made more colorful than the original version. Other similar Windows features were the use of buttons, and the flow it the system. One eleven-year-old boy even mentioned the paper clip helper in Microsoft Word when discussing various helpers.

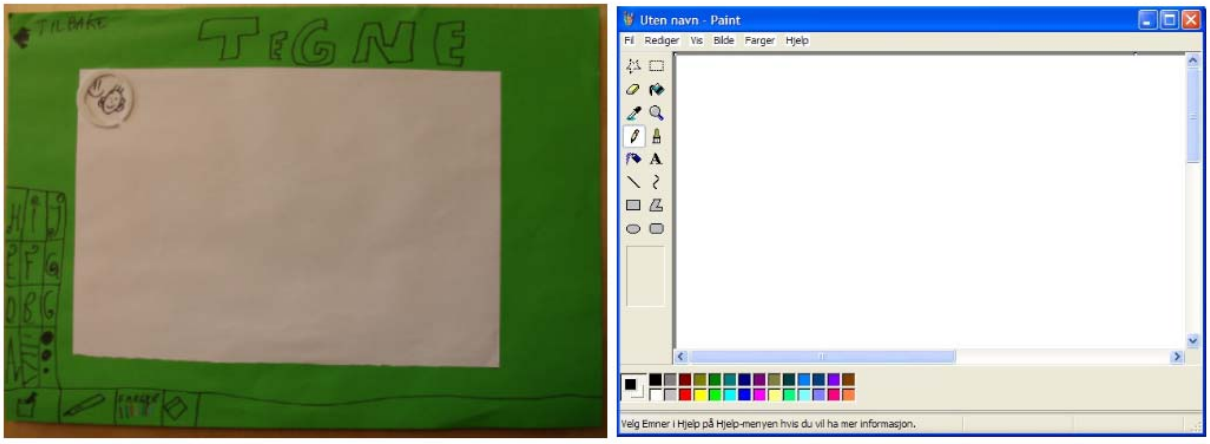


Figure 4: A child's work inspired by Windows applications; on the left is the work of a nine-year-old girl (SPS, 2005) and on the right is a screen cap from Microsoft Paint (Microsoft, 2001)

Generation Of Ideas And Tasks

In this section an overview of which task created the most ideas will be given. The result will be illustrated with tables.

In this thesis ideas are regarded as comments, feedback, ideas, thoughts, low-tech prototypes and suggestions made by the children. There has been no distinction between ideas that has taken 5 minutes to create and ideas that were generated in the spur of the moment. These ideas are considered equal in this thesis.

Each idea was given a grade based on Gilutz, Nielsen (2002) and Hanna's (1999) guidelines. An idea classified with grading 2 is an idea that matches the guidelines of Gilutz and Nielsen or Hanna. An idea classified with grading 1 is an idea that does not have a full match compared with the guidelines, but contains some elements found in the guidelines. And lastly an idea with the grade 0 is an idea that does not match the guidelines at all [14].

For the following tables and results, ideas can be coded into several categories, but an idea will remain unique within each sub category.

Generation of most ideas within tasks

Table 1 gives an overview of unique ideas within task from each session [15]. The table contains the tasks that were conducted along with how many unique ideas occurred for each grading together with the total amount of ideas.

Table 1: Overview of unique ideas from all tasks in all sessions, age and total ideas for each grading.

	Unique Ideas for each Grading			
Task	**2**	**1**	**0**	**TOTAL**
Draw/create suggestions for the system	42	35	1	78
Continue to draw/create suggestions for the system	21	13	4	38
Card sort	31	30	0	61
Try CHOICE and comments on drawings	14	27	0	41
Totals:	108	105	5	218

In the first sessions, the children created in total 78 unique ideas and 42 of these were unique with grading 2. 35 unique ideas were graded 1. 1 unique idea in total occurred with grading 0. The next session, which was a continuation of the first session, the children generated 38

[14] See page 29 for a more detailed description of the grading of ideas
[15] This table is based on the table in Appendix E.

unique ideas in total. Unique ideas with grading 2 decreased to 21 and ideas classified with grading 1 had a total of 13 unique ideas. The children created 4 unique ideas in total with grading 0. In session 3 the children were given a new task and the total amount of unique ideas were 61 and 31 of these were unique with grading 2. Children created 30 unique ideas with grading 1. None of the ideas in card sort were classified with grading 0. In the last session, the children were introduced to a new task and the total of unique ideas were 41. Ideas classified with grading 2 were 14 unique ideas. With the basis in grading 1, the children created 27 unique ideas. None of the ideas in the last session were classified with grading 0.

Since the number of children varied in sessions 1 and 3, table 1 has been broken down by age. This is done to emphasize the generation of ideas, the number of children contributing and their age. There were 4 children in total conducting session for the hospital employees. While both the nine and eleven-year-olds were 6 children at each session.

Table 2: Overview of unique ideas from each task for the 4 children of hospital employees. The average ideas created by each child are stated in the parenthesis.

	Unique Ideas for each Grading			
Task	**2**	**1**	**0**	**TOTAL**
Draw/create suggestions for the system	7	21	0	28 (7,0)
Card sort	10	11	0	21 (5,3)
Totals:	17	32	0	49 (12,3)

This table illustrates the contribution of the children of hospital employees, see table 2. These children of hospital employees generated in total 49 unique ideas regardless of grading; 28 unique ideas in the first session and 21 unique ideas in the third session. The number of ideas classified with grading 2 was 7 ideas in the first session and 10 in the following session.

The children of hospital employees suggested ideas classified with grading 2 such as various avatars and audio help. Ideas classified with grading 1 included many navigation levels by making a journey through certain body parts and various vague names for categories.

Regardless of grading, each child created in average of 7,0 ideas in the paper prototype task and an average of 5,3 ideas in the card sort. In total each child created 12,3 ideas.

Table 3: Overview of the nine-year-olds' unique ideas from each task. They were 6 children in total. The average ideas created by each child in stated in the parenthesis.

	Unique Ideas for each Grading			
Task	**2**	**1**	**0**	**TOTAL**
Draw/create suggestions for the system	18	5	0	23 (3,8)
Continue to draw/create suggestions for the system	9	6	4	19 (3,2)
Card sort	12	8	0	20 (3,3)
Try CHOICE and comments on drawings	3	12	0	15 (2,5)
Totals:	42	31	4	77 (12,8)

This table illustrates the contribution of the nine-year-olds, see table 3. They generated in total 77 ideas, regardless of grading. In the first session they created 23 unique ideas, 19 unique ideas in the second session, 20 unique ideas in the third and lastly 15 unique ideas in the last session. In total the children generated 42 unique ideas with grading 2 in the four sessions they participated. The first and third session generated the most unique ideas classified with grading 2 for the nine-year-olds with 18 and 12, respectively. The third and fourth sessions created the most unique ideas classified with grading 1 with 8 and 12 ideas, respectively. During the second task, 4 ideas were classified with grading 0.

The nine-year-olds suggested ideas classified with grading 2 such as use of slide-bar, animation to indicate various symptoms, and have a heart as the background for feelings. Ideas classified with grading 1 included bursting soap bubbles with questions and limited help sections. The nine-year-olds suggested ideas with grading 0 such as scrolling in a window and a specific ocean game.

The nine-year-olds created, regardless of grading, 3,8 ideas in average in the paper prototype task, 3,2 and 3,3 ideas in average in continuation of paper prototype and card sort,

respectively. In the last task these children created 2,5 ideas in average, with a total of 12,8 ideas in average for each child.

Table 4: Overview of the eleven-year-olds' unique ideas from each task. They were also 6 children in total. The average ideas created by each child in stated in the parenthesis.

	Unique Ideas for each Grading			
Task	**2**	**1**	**0**	**TOTAL**
Draw/create suggestions for the system	17	9	1	27 (4,5)
Continue to draw/create suggestions for the system	12	8	0	20 (3,3)
Card sort	9	11	0	20 (3,3)
Try CHOICE and comments on drawings	11	15	0	26 (4,3)
Totals:	49	43	1	93 (15,5)

The eleven-year-olds created in total 93 ideas, regardless of grading, see table 4. The children generated 27 unique ideas in the first session, 20 in the second and third session and 26 during the last session. The most unique ideas with grading 2 were created in the first two sessions; 17 and 12 ideas respectively. In the third and fourth session, the eleven-year-olds created the most ideas with grading 1 with 11 and 15 ideas respectively. During the first task, 1 ideas was classified with grading 0.

Ideas that were given the grade 2 included helper throughout the program, various rewards and different items change color when they have been visited or used. The eleven-year-old children also suggested ideas the was classified as grading 1 such as help texts as only support for the user and various vague names on categories and items. The eleven-year-olds generated one idea with grading 0, which involved the use of navigation in a non standard way.

Regardless of grading, each eleven-year-old created in average of 4,5 ideas in the paper prototype task, 3,3 ideas in both continuation of paper prototype and the card sort. And in the last task they created 4,3 ideas in average. In total, each child created an average of 15,5 ideas.

Ideas Classified

The children generated many ideas about various aspects of the system and this coincides with my aim to explore usability. I created the following seven main usability categories in the analysis of the ideas; user variation, media, content, help features, interaction, input, and experience. These main categories are based on guidelines from Gilutz and Nielsen (2002) and Hanna (1999). The main usability categories consist of one or more sub categories (sub). Furthermore, some of the sub categories consist of sub categories (sub 2). The children's ideas were classified within these main, sub and sub 2 categories. The tables illustrates that the children had more focus on some features of the system than others. This resulted in that the children created more ideas about certain aspects of the system, such as animation, audio, navigation, interaction, methods for input and avatar than for example user variation, font, and language.

The following 7 tables illustrate how many ideas were classified within each of my 7 main categories. The results will be presented with tables and the children's work from the sessions. For the following tables and results, ideas can be coded into several categories, but an idea will remain unique within each sub category.

User Variation

The main category *user variation* has two sub categories; *age* and *gender*. The first covers the children's suggestions related to a particular age. This category was used when the children suggested ideas regarding children younger than themselves, which covered understandability problems such as an eleven-year-old boy suggested during the card sort: "*it's smart with sound in the program so the ones that are younger can understand what they're supposed to do*" [16]. He illustrated this by drawing a button with a picture of an ear. Another suggestion to indicate audio in the system was to draw a speaker, done by a nine-year-old girl, see Fig.5.

[16] All the quotes are originally in Norwegian and have been translated for this thesis.

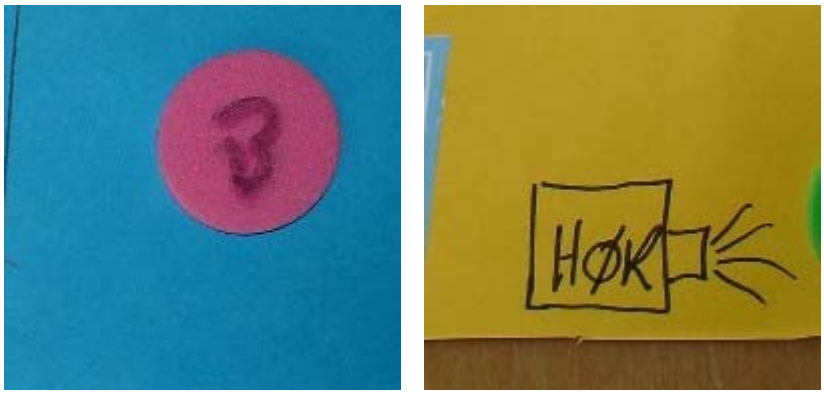


Figure 5: Children suggested various ideas concerning children younger than themselves. To help children who cannot read, the children created a button with the image of an ear (to the left) and speaker with the word "listen" (hør) written on it (to the right) (SPS, 2005).

The categories along with the occurrences of the ideas for user variation, is shown in table 5.

Table 5: The category *user variation* with ideas classified with grading 2 and 1. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Occurrences for each grading			
		Unique ideas		Total ideas	
		2	1	2	1
User variation					
	Age	3	0	4	0
	Gender	0	2	0	2
	Totals:	5		6	

The second sub category, gender, is used if the children suggested specific ideas for girls and respectively for boys. Boy, age 11, suggested during the card sort: "*little girls thinks that the mermaid Ariel is so cool and stuff*" while an eleven-year-old girl suggested during the same task: "*for boys it could be Spider-man or Superman*".

In total the children generated 6 ideas, to which 5 were unique. 3 ideas of the age category were classified with grading 2, while 2 gender ideas were classified with grading 1. None of the ideas in user variation were classified with grading 0.

Media

The second main category *media* consists of ideas such as moving characters, voice/talk and sounds, see table 6. This category has two sub categories: *animation* and *audio*. Animation has four different sub categories: *character*, *body*, *wallpaper animation* and *miscellaneous ideas of animation*. The first sub 2 category, character, is used when the children suggested moving characters. A ten-year-old girl, in the third session, wanted: "*the mermaid to come up from the water and help*".

The next sub category, body, contains the children's ideas classified in regards to moving bodies or body parts and was illustrated by a nine-year-old boy: "*the body could turn back and forth so that you can click where you hurt, you can hit better if you can turn the body*".

The sub category, wallpaper animations, is used to classify the children's ideas involving background animations. The classifications is illustrated with a nine-year-old girl's suggestion in the card sort: "*the train could stand still but the background could be moving, a background with mountains*" and a ten-year-old girl who suggested: "*island with boats that you can steer between*".

The last sub category is miscellaneous ideas of animation, which collects ideas made by the children regarding animation not included in the other sub categories, such as "*more and more things pop up that you shot at*", a suggestion made by an eight-year-old boy in the paper prototype task. Or "*more colors and graphics*", an idea created during the testing of CHOICE from an eleven-year-old girl. These are examples of ideas classified into the sub 2 category miscellaneous ideas of animation.

Table 6: The category *media* with ideas classified with grading 2 and 1. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading			
			Unique ideas		Total ideas	
			2	1	2	1
Media						
	Animation					
		Character	5	0	8	0
		Body	6	0	9	0
		Wallpaper animation	1	3	2	3
		Miscellaneous ideas of animation	0	9	0	9
	Audio		13	1	23	1
		Totals:	38		55	

The other sub category of media is *audio* and classified the children's ideas regarding different aspects of sound. A boy, age 11, suggested during the second session: "*a mechanical voice that can tell you what to do*" while a ten-year-old girl suggested during the first session: "*the system can applaud when you hit the target*".

In the media category there were in total 38 unique ideas, regardless of grading. The most ideas within the sub category animation with grading 2 were classified in the character and body categories. Many of the children ideas were sorted in the category audio; 23 in total and of these 13 were unique. Within the ideas classified with grading 1, the ideas regarding miscellaneous ideas of animation stood out with the total of 9 unique ideas. None of the ideas in media were classified with grading 0.

Content

Content, the third main category focuses on usability criteria and navigation, see table 7. The category has seven sub categories; *font*, *language*, *start page*, *interface*, *navigation*, *reward* and *category names*.

Font

Ideas regarding font size, text on the background or animated text are classified in the first sub category; font. This sub category has two sub categories: *animation* and *readability*. The first sub category is used if the involved children suggested ideas about text with change of color or text on colored backgrounds. The classification is illustrated by the suggestion of an eleven-year-old girl: "*the text can change color when you have been there*".

The second sub category, readability, contains the suggestions made by the children about the font size and suitable size on text to achieve a sufficient level of readability. A nine-year-old boy's suggestions during the testing of CHOICE: "*the text is ok to read*", exemplifies the classification.

Language

The second sub category of content is language. The children's ideas about language in the system were classified in this sub category. This category contains two sub categories; *understandability* and *readability*. The former is used when children gave feedback and suggestions regarding how much they understood of a text. The latter is used when children's ideas involve the use of language or use of wordings. When children were given a system to test, they gave feedback during the testing of CHOICE such as: "*the language is too adult for us*", by an eleven-year-old boy, and "*the text is too long*", commented by another eleven-year old boy at the same session.

Start page

Content's third sub category is start page and classifies the involving children's ideas in regards of the start page of a system. One nine-year-old commented during the fourth session: "*it's too much stuff on the first picture*".

Table 7: The category *content* with ideas classified with grading 2, 1 and 0. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading					
			Unique ideas			Total ideas		
			2	1	0	2	1	0
Content								
	Font							
		Animation	1	1	0	1	1	0
		Readability	1	2	0	1	3	0
	Language							
		Understandability	1	5	0	1	7	0
		Readability	1	3	0	1	4	0
	Start page		0	1	0	0	1	0
	Interface							
		Wallpaper	4	6	1	4	7	1
		Items	4	1	0	5	1	0
	Navigation							
		Levels of navigation	1	6	0	1	7	0
		Breadcrumbs	4	2	0	5	2	0
		Dynamic vs. static movement	3	9	1	4	9	1
		Icons for navigation	4	1	0	7	1	0
		General design ideas	1	3	1	1	3	1
	Reward		3	5	0	3	5	0
	Category names		5	2	0	7	2	0
		Totals:	83			97		

Interface

Interface is the fourth sub category in the main category content. This sub category is used to classify the children's ideas regarding screen layout, characters and wallpapers. Furthermore, interface has two sub categories; *wallpaper* and *items*.

The first is used to classify the children's ideas regarding wallpapers such as colors and characters. The trio of eleven-year-old girls suggested: "*each color on the background contains different levels*", see Fig.6. The picture illustrated the use of colors for the background. This is an example of an ideas classified in the sub 2 category wallpaper.

Figure 6: One idea classified in the sub 2 category wallpaper included the use of colors, where each color had a meaning. Three eleven-year-old girls created this idea (SPS, 2005).

The second sub category, items, classified items and objects such as signs or trains. Some of the ideas classified in this category were "*buttons in different colors to push on*" by an eleven-year-old boy during the first session, see Fig. 7. The picture illustrates several buttons in various colors that the user can click on. Further, a ten-year-old girl suggested in the card sort task to "*make a sign on each island*" and "*we can have a train*"; an idea also created by an eight-year-old girl in the same task.

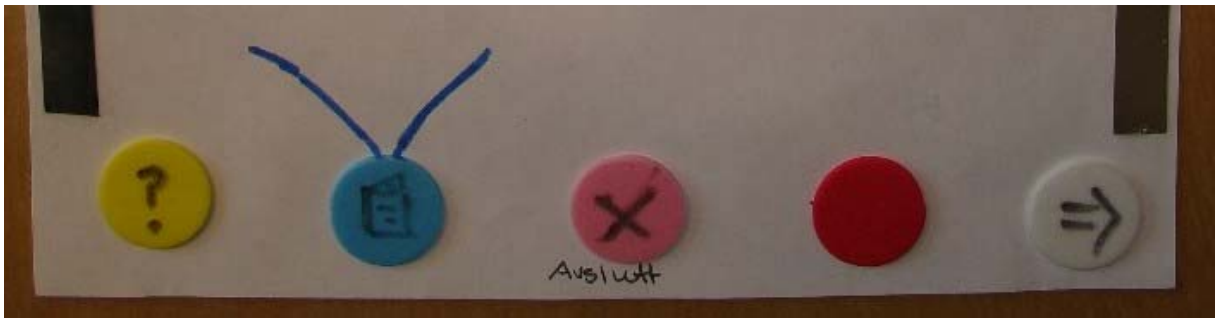


Figure 7: An eleven-year-old boy made various buttons in different colors during paper prototyping. This ideas is classified in the sub category items (SPS, 2005).

Navigation

The fifth sub category is navigation[17]. Navigation has five sub categories; *level of navigation*, *breadcrumbs*, *dynamic vs. static movement*, *icons for navigation* and *general design ideas*. The first sub category, level of navigation, has classified the various suggestions from the children in regards to different courses, levels and screen layouts that have consequences for the levels of navigation in a system. The classification is exemplified with the suggestion of an eight-year-old boy in the pilot testing in the first session who explained during the paper prototyping: "*we used levels so that we can get more challenges*", see Fig. 8. As the drawing illustrates, there are various tasks that needs to be completed in the amusement park, like the merry-go-around to the right and the boat exercise to the left, before going to a more challenging course by following the "next course" arrow up in the right corner.

[17] In this thesis navigation is regarded as how the user moves from one state to another by using buttons, doors, arrows or other items.

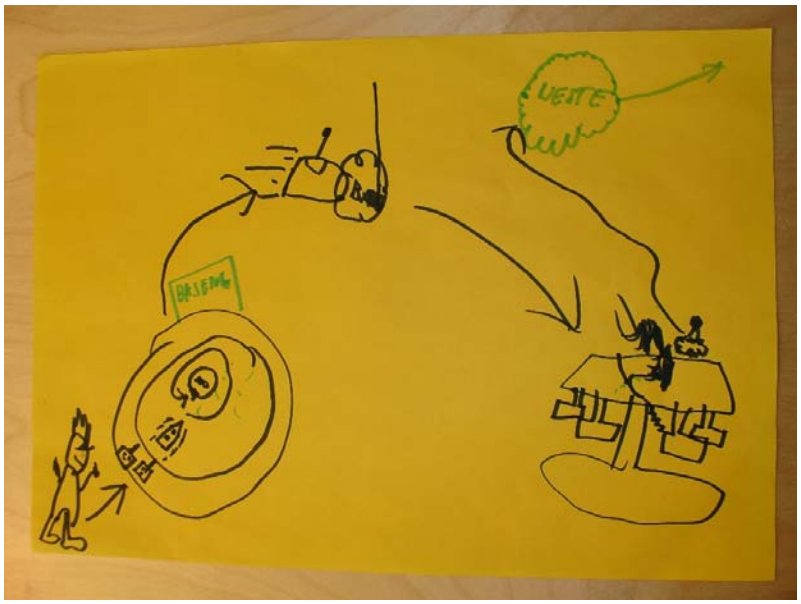
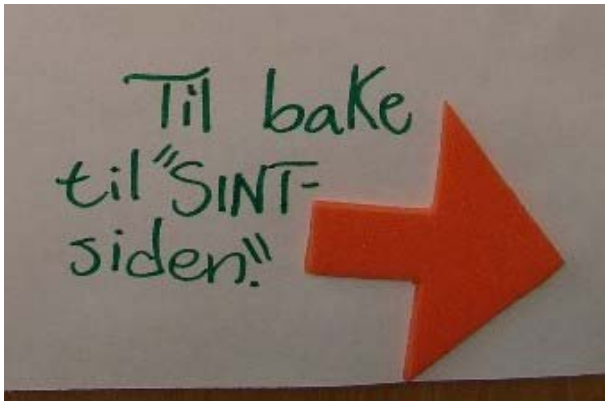


Figure 8: An eight-year-old boy created an idea where various needs to be completed before going to a more challenging level by going to the upper right corner and the "next course" arrow. This idea is classified in the sub category level of navigation (SPS, 2005).

The second sub category, breadcrumbs, is based on the Hansel and Gretl's path of breadcrumbs that can trace back to where the user has been. The children's suggestions regarding various tracking mechanisms were classified in the breadcrumb sub 2 category. This classification was illustrated by an eleven-year-old girl in the first session: "*after we've been there it'll change color*" and a ten-year-old girl suggested in the last session that: "*the cow can go to sleep after we've been there*".

The children's suggestions concerning movement, which involves forth and back versus the movement made forth but not back again, were classified in the third sub category: dynamic vs. static movement. During the last session a girl, age 10, suggested: "*clicking where you want to go*", an eight-year-old boy suggested "*to draw a line on the monitor to steer the boat*" during the fourth session. These are examples of ideas classified in the sub 2 category dynamic vs. static movement. In the fourth sub category, icons for navigation, the children's ideas concerning various items that lead the user further into the system have been classified in this sub 2 category. This classification is illustrated by the suggestions of two nine-year-olds: "*we can have arrows like these*", see Fig. 9, and "*you have to click on the door twice to get out*", see Fig. 10. The first nine-year-old created an arrow so that the user can navigate to a previous page; which in this case was back to the "angry page". The second nine-year-old suggested a door that can be used to leave a section by clicking on it twice.



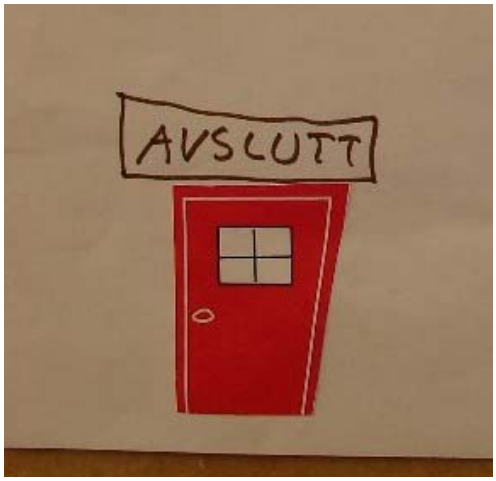


Figure 9 (left): A nine-year-old girl created an idea classified in the sub category icons in the sub category navigation; an arrow, which leads the user back to the "angry page" (SPS, 2005).

Figure 10 (right): Another nine-year-old created an idea of a door that needs to be clicked on twice to leave a section. This idea was classified in the sub category icons in the sub category navigation (SPS, 2005).

General design ideas is the last sub 2 category in the sub category navigation (main category content, see table 7. Various aspects around design suggested by the contributing children such as different levels and menus have been classified in the sub 2 category general design ideas. An eleven-year-old girl illustrates this classification during the second session: "*you can scroll in the window if you need more space*", see Fig. 11. This picture shows a window where the user can scroll.

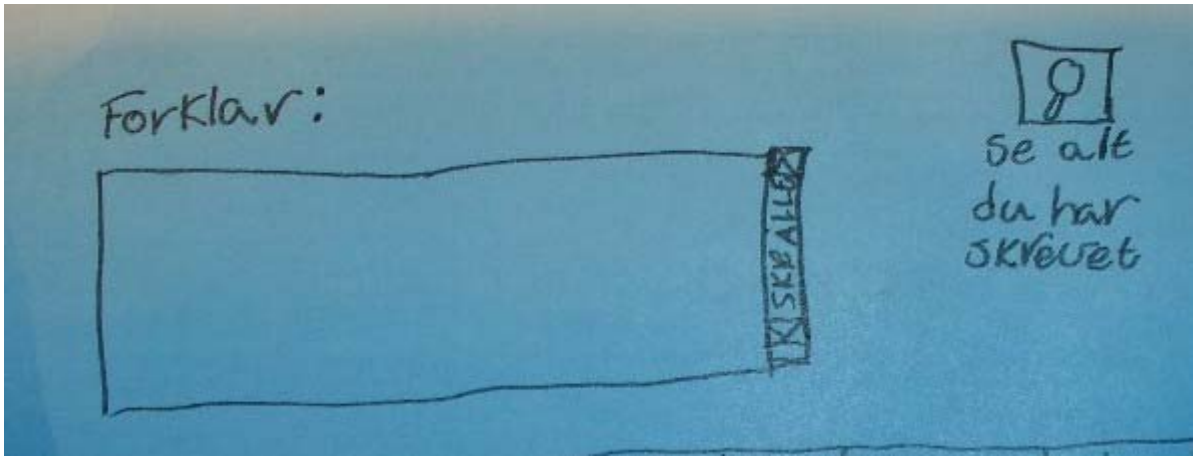


Figure 11: An idea classified in the sub 2 categories general design ideas concerned a window with scrolling possibilities (SPS, 2005).

Reward

The sixth sub category for content is reward and contains classifications regarding different rewards after accomplished tasks. A boy, age 8, suggested when working with the paper prototype in the first session: "*you can get a diploma when you're done*" while a ten-year-old girl suggested during the card sort: "*to collect pieces of cheese and cucumbers, so you can make some food*".

Category Names

The last sub category in the main category content is category names and contains classifications concerning names for different categories meant for the system. This is illustrated with a ten-year-old girl's suggestion of "*feelings inside*" and "*feeling outside*", an eight-year-old boy suggested "*sleep*", a girl, age 10, created the category name "*medication*" and an eleven-year-old boy suggested "*stomach problems*". All the ideas are from the third session, the card sort. The categories along with the occurrences of the ideas for content, is shown in table 7.

In the sub categories with grading 2 in the main category content, see table 7, some occurrences were higher than others, such as items, icons for navigation, and category names. Some of the unique ideas classified with grading 1 have higher occurrences than others such as understandability, wallpaper, levels of navigation, dynamic vs. static movement and rewards. Three of the ideas that did not match Nielsen (2002) or Hanna's (1999) guidelines, and were given the grade 0, occurred in the following sub categories; wallpaper, dynamic vs. static movement and general design ideas.

Help Features

The next main category is *help features* and the children's suggestions of various help features are classified in this category. The main category has three other sub categories: *helper*, *explanation* and *audio and visual help*. The first sub category is used to classify ideas regarding a helper assisting the user throughout the system. An eleven-year-old boy exemplifies this during the first session: "*there's a helper up in the corner*", see Fig. 12, and another eleven-year-old boy suggested during session 2, "*a doctor can be a helper*", see Fig. 13. The first picture shows the helper in a close up. In this boy's system the helper is located

up in the right corner and talks to the user. The other picture shows a doctor, who is the helper in the system, explaining the system to the user (here represented by the avatar).

Figure 12: An eleven-year-old boy suggested an idea of a helper up in the right corner in the system. This ideas is classified in the sub category helper (SPS, 2005).

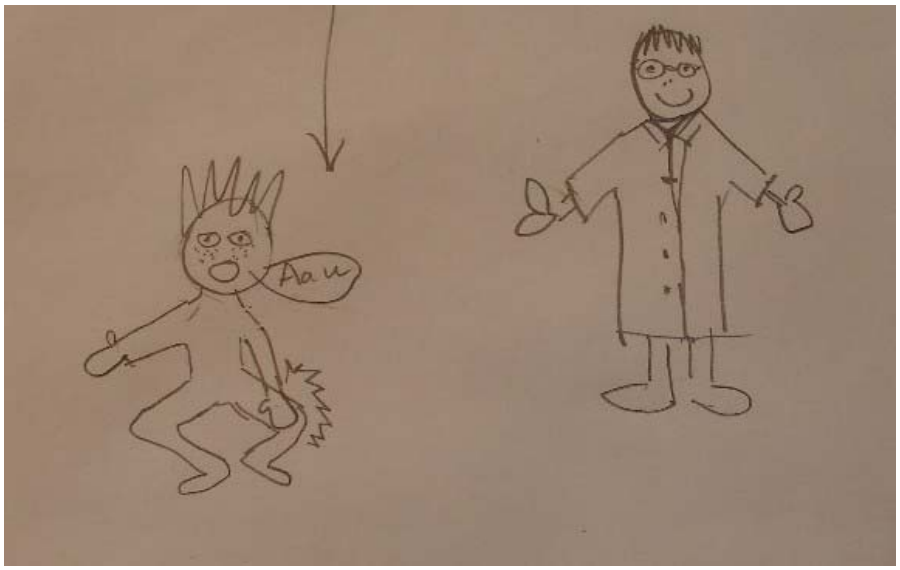
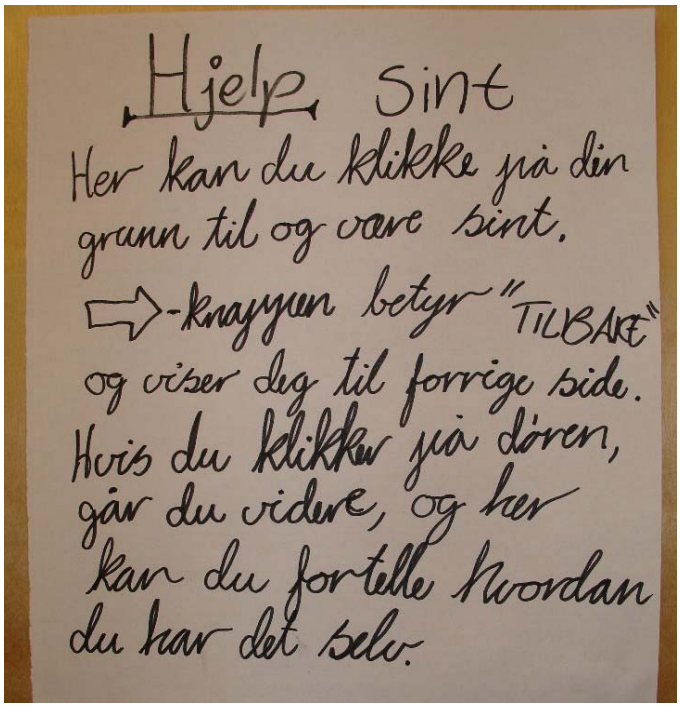


Figure 13: An idea classified in the sub category helper concerns a doctor as a helper (to the right) (SPS, 2005).

The next sub category is explanation and the children's suggestions concerning assistance by explanations about what to do in the system, are classified here. A nine-year-old boy illustrates this with a suggestion: "*click on it to get an explanation*" and a girl, age 9, suggested in the second session: "*this shows the help text*", see Fig. 14. This picture shows the explanation concerning arrows, buttons and content in the "angry" section of this girl's system.



The last sub category, in the main category help features, is audio and visual help and is used to classify suggestions regarding aid in connection to audio or visual assistance such as a voice reading a text or by clicking on a button for help. This is illustrated with the suggestion by a nine-year-old girl in the first session: "*you can have a dialogue with Tomas [an avatar] who asks you how you feel*", see Fig. 15. The picture shows Tomas the avatar to the left talking to the user. The results of the help features categories are shown in table 8.

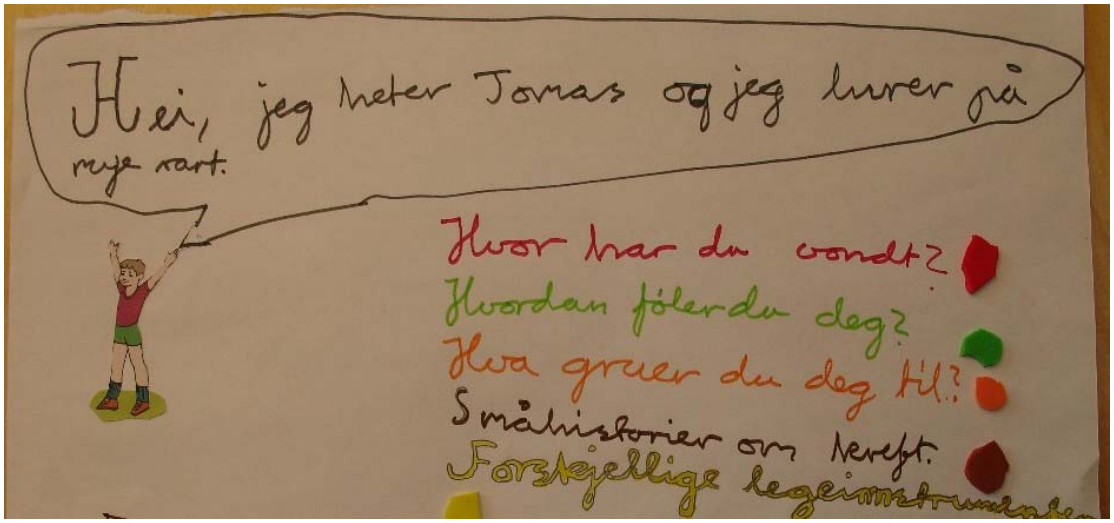


Figure 14: An idea classified in the sub category audio and visual help concerns the user having a dialogue with the avatar Tomas (SPS, 2005).

Table 8: The category *help features* with ideas classified with grading 2 and 1. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading			
			Unique ideas		Total ideas	
			2	1	2	1
Help features						
	Helper		4	3	6	4
	Explanation		2	3	2	3
	Audio and visual Help		3	1	3	1
		Totals:	16		19	

The sub category, which stands out within the grading 2 ideas, is the sub category helper with 4 unique ideas and 6 ideas in total. Within the ideas with grading 1, two sub categories stand out; helper and explanation, both with 3 unique ideas. None of the ideas in help features were classified with grading 0.

Interaction

In the fifth main category is *interaction,* the children's suggestions concerning means for the user to interact with the system are classified in this main category. It has four sub categories; *standard interaction schemes, exits, icons* and *symbols*. The first is used to classify children's ideas regarding well-known methods for interaction. The children's ideas were "*a menu over where the pain is*", suggested by a nine-year-old girl during the first session, "*buttons in different colors that you can click on*", see Fig. 7, suggested by a eleven year old boy during the first session, and "*use arrows to wind the train forward*", proposed by a nine-year-old girl during the third session. These are examples of ideas classified into the sub category standard interaction schemes.

The children's ideas concerning various ways of indicating that the user is leaving a section of the system, is classified in the second sub category, exits. This is exemplified by the suggestion of a ten-year-old girl: "*click on the door and it will open up*", see Fig. 16. The

picture illustrates various numbered doors that will open when clicked on and lead the user out of the current section or into new ones.

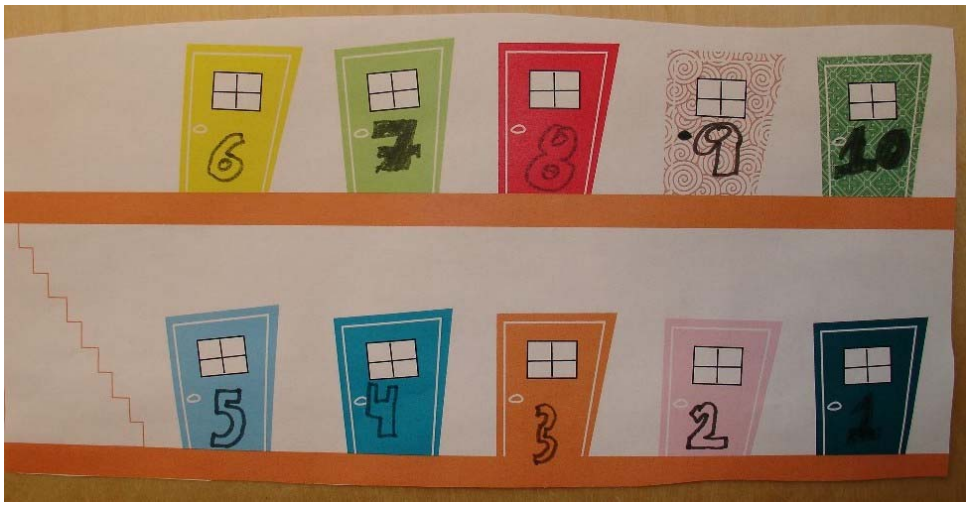


Figure 15: An idea was generated regarding doors that will take the user back in the system or leave it. This idea is classified in the sub category exits (SPS, 2005).

The children's suggestions regarding different icons for interaction is classified in the third sub category, icons. This was illustrated by a ten-year-old girl: "*doors to get in or out*" while an eight-year-old boy suggested when working with his paper prototype: "*click on the animated faces to get to the next level*". The last sub category, symbols, is used to classify items that the children created associations with symptoms, illness, items and colors. An eleven-year-old girl exemplified this by suggested during the second session: "e*ach color in the background represent a level, like green is a flowery meadow and you're riding on a lady bug in a tree, and yellow is a ray of sunlight and you're riding on the sunbeam express*", see Fig. 6. A ten-year-old girl suggested during the card sort session: "*nausea is on the merry-go-around, scared on the haunted house and stomach problems on the roller coaster. School is missing friends and family*". While another ten-year-old girl suggested in the same session: "*the roller coaster means scared*". The ten-year-old girls also created a tree where each branch on the tree symbolized different feelings. The categories along with the occurrences of the ideas for interaction, is shown in table 9.

Table 9: The category *interaction* with ideas classified with grading 2 and 1. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading			
			Unique ideas		Total ideas	
			2	1	2	1
Interaction						
	Standard interaction schemes		7	7	13	8
	Exits		2	0	5	0
	Icons		6	5	11	5
	Symbols		1	6	1	8
		Totals:	34		51	

In the sub category standard interaction scheme, there are 13 ideas in total classified with grading 2, of which 7 ideas was unique. Another sub category with grading 2, which stands out, is icons with 6 unique ideas out of a total of 11 ideas. When it comes to ideas with grading 1 there is an even distribution of ideas in standard interaction scheme, icons and symbol with 7, 5 and 6 unique ideas respectively. There is a difference between the ideas classified with grading 2 and 1 in the sub category symbols, with 1 and 6 ideas, respectively. None of the ideas in interaction were classified with grading 0.

Input

The children's ideas regarding all possibilities for entering information, either reporting symptoms or by the choice of avatars are classified in the sixth main category, input. This category has two new sub categories; *input for information* and *avatar*. Input for information, the first sub category, is used to classify all the suggestions by the children for entering information. Furthermore, this sub category has two sub categories; *method for information input* and *other ideas for input*. In the first sub category, the children's ideas concerning various ways for reporting symptoms, is classified in the sub category method for information input. This is exemplified by an eleven-year-old boy who suggested during the second session: "*click on the place on the body where it hurts*", see Fig. 17. This picture illustrated a leg with many possible places for the user to click on depending on where it hurts. Further, a

boy, age 11, suggested also during the same session: "*click on the animated character if this is how you're feeling*" or "*you take these dots and drag them over where it hurts on the body. The stronger the color the more pain you've got*" was created by a nine-year-old girl during the first session, see Fig. 18. This picture shows an explanation of the color scale, with dark colors indicating much pain and light colors indicating little or no pain. At the bottom are the colored dots the user can drag over to the body on the left hand side to indicate where on the body the user hurts. A boy, age 11 suggested: "g*rade the pain by using smileys*", see Fig. 19. This picture shows the different smileys the user can chose from to grade the pain.

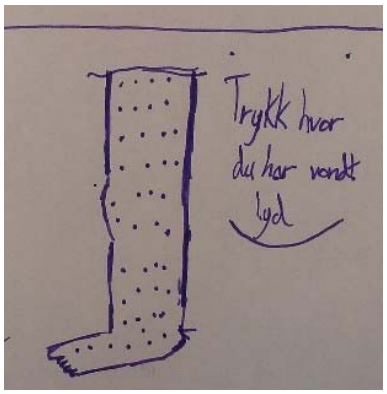


Figure 16: An eleven-year-old boy suggested that the user could click on the leg to indicate where it hurts. This idea was classified in the sub category method for information input (SPS, 2005).

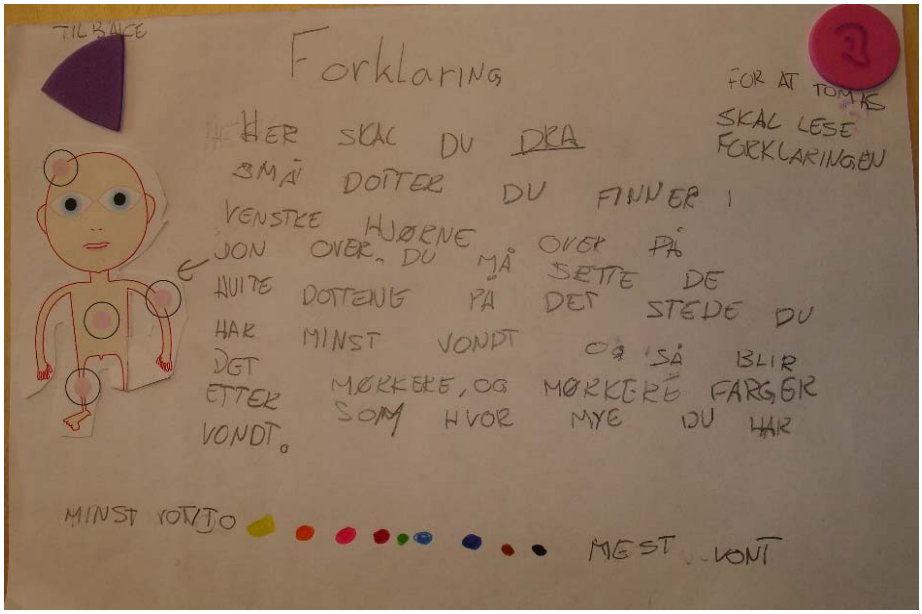


Figure 17: A nine-year-old girl suggested that the user could report pain by using various colored dots where each color indicated the degree of pain. This idea was classified in the sub category method for information input (SPS, 2005).

Figure 18: One idea classified in the method for information input concerned indication of pain with the help of smileys (SPS, 2005). An eleven-year-old boy generated this idea.

The other sub category, other ideas for input, is used to classify other ideas that did not fit into the other sub categories. A girl, age 11, suggested during the continuation of the low-tech prototype: "*file names and save what you have done*" while another eleven-year-old girl suggested during the same session "*if you have been to the same level before, you can create a new username and play the same level one more time*". These are examples of ideas classified into the sub category other ideas for input.

In the second sub category for input, avatar, is used to classify all possible representation of the user made by the contributing children. This classification is illustrated by a nine-year-old girl: "*name your own character*" while a girl, age 11, suggested during the work with the paper prototypes "*the program asks for the name of the user, then you can chose hair color, eye color, gender, clothes – it's all really detailed*", see Fig. 20. This picture shows how the user can chose various features for the avatar such as hair color, hairstyle, clothes and eye color. Further, another eleven-year-old girl suggested in the same session: *"we can have both animals and humans to choose from*", see Fig. 21. The picture illustrates various avatars, including humans and animals, which the user can choose from. The results of the input categories are shown in table 10.

Figure 19: The children generated various ideas concerning avatars. One idea dealt with various choices the user could do to make an avatar. An eleven-year-old girl proposed this idea (SPS, 2005).

Figure 20: Another eleven-year-old girl suggested the idea that the user could choose from various avatars, including both humans and animals (SPS, 2005).

Table 10: The category *input* with ideas classified with grading 2, 1 and 0. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading					
			Unique ideas			Total ideas		
			2	1	0	2	1	0
Input								
	Input for information							
		Method for information input	9	4	0	11	4	0
		Other ideas for input	0	4	1	0	4	1
	Avatar		7	2	0	16	2	0
		Totals:	27			38		

Two sub categories with grading 2 stand out; method for information input with 9 unique ideas out of a total of 11 and avatar with 16 ideas in total, where 7 are unique. Within the categories with grading 1, there is an even distribution of the ideas in method for information input and other ideas for input, both with a total of 4 unique ideas. One category contains an idea with grading 0 and it is other ideas for input. The sub 2 category other ideas for input contains 1 idea classified with grading 0.

Experience

The children's ideas regarding their own ideas and feedback when presented with suggestions and low-tech prototypes, are classified in the seventh main category, *experience*. This category has one sub category, *interpretation of how the system should be*. This sub category is used to classify the children's comments or ideas about how the system should be according to them. Furthermore, the sub category comprehension of how the system should be, have three sub categories: *extra features*, *spin-off ideas* and *color, graphic and details*. In the first sub category, extra features, is used to classify the children's ideas that are not considered a necessity, but optional. This is illustrated by a nine-year-old girl: "*you should have a button for saving*" or a girl, age 11, suggested in the second session, "*the program*

should ask the user if he has played it before and ask for a username and password". A nine-year-old girl suggested during the fourth session: "*click twice on something were the second click deactivates the first click*". A nine-year-old girl suggested in the first session: "*have a menu with information of medical equipment and little stories about cancer*", see Fig. 22. The picture illustrates the menu, which includes information about various medical equipment and short stories about cancer.

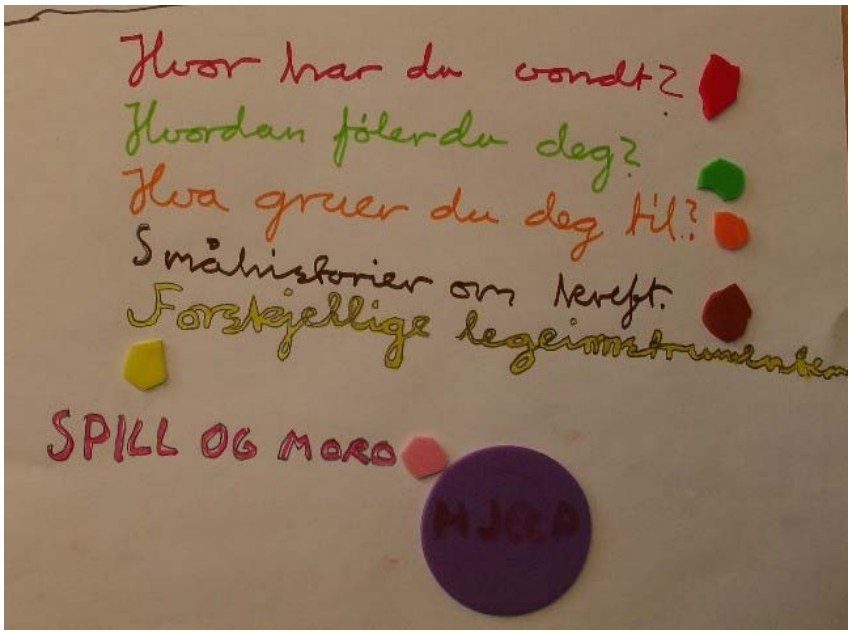


Figure 21: A nine-year-old girl suggested a menu with information of medical systems and little stories about cancer (SPS, 2005). This idea was classified in the sub category extra features.

The children's ideas concerning comments and feedback when presented with drawings or prototypes, are classified in the second sub category, spin-off ideas. An eleven-year-old boy commented during the third session that: "*you should have a sign on each category in the galaxy*" and a nine-year-old girl suggested in the same session: "*if there is a treasure chest it should also be a key*". These are examples of ideas classified in the sub category spin-off ideas. In the last sub category, colors, graphics and details, the children's ideas regarding color, graphics and details when drawings and prototypes were presented to them. An eleven-year-old girl exemplifies this classification: "*It needs more details, not just a body with head and legs and stuff, but more real, more details*". Further, another girl, age 11, suggested during the second session: "*you need different characters to chose from*". When testing the CHOICE, an eleven-year-old boy said: *"If you're really nauseas, you're hardly able to do anything* " while another eleven-year-old boy said: *"If I'm sick it's OK by me to use CHOICE.*

If I'm really sick I don't wanna do anything. But if I'm a little sick, it's OK to use CHOICE". The categories along with the occurrences of the ideas for experience, is shown in table 11.

Table 11: The category *experience* with ideas classified with grading 2, 1 and 0. Total of unique ideas and total ideas are summarized in the row marked totals.

Main category	Sub category	Sub 2 category	Occurrences for each grading					
			Unique ideas			Total ideas		
			2	1	0	2	1	0
Experience	Interpretation of how the system should be	Extra features	2	4	0	2	4	0
		Spin-off ideas	2	3	1	2	3	1
		Color, graphic and details	2	1	0	2	1	0
		Totals:	15			15		

The ideas with grading 2 are evenly distributed with 2 unique ideas in total in the following sub categories; extra features, spin-off ideas and color, graphics and details. The categories containing ideas with the grading 1 are also evenly spread out with 4 unique ideas in total in the sub categories extra features, 3 unique ideas in the sub category spin-off ideas, together with color, graphic and details with 1 unique idea in total. One idea was classified with grading 0 in the category spin-off ideas.

The tables 5 to 11, reveal that the children create more ideas within certain categories compared to others. For ideas classified with grading 2, the main category media with the sub categories animation and audio have high occurrences. The main category interaction has the sub categories standard interaction schemes and icons that points out with more ideas than the other sub categories in the same category. Further the main category input with the sub categories method for input and avatar have a high occurrence of ideas.

Ideas classified with grading 1 in the tables 5 to 11, shows that also here there are categories that have a higher number than others. In the main category media with the sub category

miscellaneous ideas of animation points out compared to the other ideas with grading 1 in the same sub category. In the main category content, the sub categories dynamic vs. static movement, wallpaper and levels of navigation have a high occurrence of ideas. Further, the main category interaction with the sub categories standard interaction schemes and symbols points out.

Ideas Consistent Or Inconsistent with Usability Criteria Guidelines

The table below summarizes and gives an overall view of the tables 5 to 11. For the following tables and results, ideas can be coded into several categories, but an idea will remain unique within each sub category. The categories are based on the usability criteria by The Nielsen Norman Group (2002) and Hanna (1999) and focused on usability. Since my aim is to explore usability, the table gives an overview of which ideas are consistent, i.e. given the grading 2, with Nielsen (2002) or Hanna's (1999) guidelines and which are inconsistent, i.e. given the grading 1 and 0.

The ideas classified with grading 2 are ideas that are consistent with the guidelines proposed by the Nielsen Norman Group or Hanna. These ideas are examples of usable ideas. The ideas that are only partial consistent with the usability guidelines, counter these guidelines in at least one way. Thus, the usability in these ideas is not as optimal as it could have been. Therefore, these ideas may serve more as inspiration for designers who can create new ideas. The ideas that are classified with grade 0 do not match the guidelines at all and the usability aspect in these ideas is poor. Therefore, the table below has one column, where ideas are both classified with grading 2 and is consistent with the usability criteria by Gilutz, Nielsen (2002) and Hanna (1999). And another column contains the ideas classified with both grading 1 and 0 and inconsistent with the Nielsen or Hanna's guidelines.

Table 12: Overview of the categories based on all the ages and all session. The ideas are summarized with ideas in total along with consistent and inconsistent ideas with the usability criteria.

Category	Number of unique ideas	Consistent with criteria (grad 2)	Inconsistent criteria (grad 1+0)
User variation (age, gender)	5	3	2
Media (animations, sound)	38	25	13
Content (font, language, start page, screen layout, navigation, reward, category names)	83	33	50
Help Features (helper, explanations, audio and visual help)	16	9	7
Interaction (standard interaction features, exits, icons, symbols)	34	16	18
Input (input for information, avatar)	27	16	11
Experience (interpretation of how the system should be)	15	6	9
Totals:	218	108	110 (105 + 5)

Consistency

My analysis shows that the children generated 108 ideas that were classified as consistent with the criteria guidelines of Nielsen (2002) and Hanna (1999), see table 12. This makes up for about half of the total ideas of 218. Media is the category with most consistent ideas, when compared with usability criteria of the Nielsen Norman Group and Hanna. In this category, 25 of the total 38 unique ideas were classified with grading 2. Examples of consistent ideas classified in the media category included different animated faces to indicate various

symptoms and audio that helps the children understand what to do. Media was the only category where the number of ideas classified as consistent was much greater than ideas classified as inconsistent. The categories help features, interaction, input and experience did not have a big difference between the consistent and the inconsistent ideas. Suggestions classified in the category help features, included having the text read out loud and a helper (character) that followed the user throughout the system. These ideas are supported by guideline number 21 "*Help inexperienced readers by supplementing text with other kinds of explanation*" [18]. Guideline number 68 also supports the ideas: "*Design characters that kids can identify with*".

Examples of the children's ideas that were classified in the interaction category were use of buttons and arrows, and use color to symbolize the meaning of sections. These ideas are backed up by guideline number 4: "*Use standard interaction schemes. Use well-known navigation and interaction methods that are common*". Guideline number 11 also supports the ideas: "*Use icons and symbols in familiar ways*".

The category input classified ideas such as clicking on places that hurt on the body and grading of answers. A nine-year-old boy suggested: "*you have these buttons that you can click on to say why you're angry*", see Fig. 23. This picture illustrates that the system suggests three reasons for being angry. The user can chose the desired reason by clicking on the buttons (in the shape of a picture) on the left hand side. This idea is supported by the combination of 2 guidelines. First, is guideline number 4: "*Use standard interaction schemes Use well-known navigation and interaction methods that are common*". The second guideline is number 37: "*Use standard navigation and search schemes. Many kids are familiar with these conventions and use them easily*".

[18] See Appendix D for references for the guidelines by Nielsen Norman Group

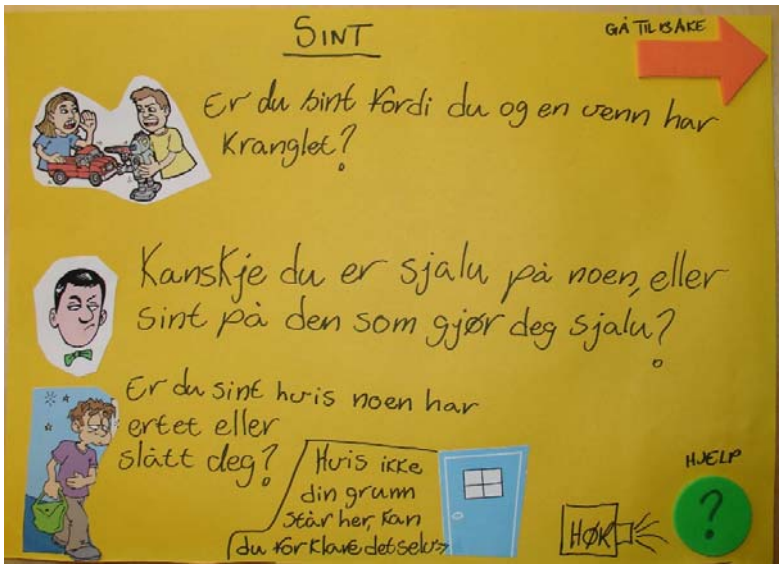


Figure 22: A nine-year-old boy suggested various buttons for the user to choose the reason for her or his current mood. This idea is classified in the main category input (SPS, 2005).

Suggestions regarding experience included username and password, features for saving, generally more graphic and colors throughout a system.

Generation of most consistent ideas in task

The analysis of the children's ideas shows that the children generated the most ideas classified with grading 2 during the first session when they were asked to create their own version of the system by using paper, glue, pencils etc., see table 1. During this process, 42 ideas in total were classified as unique with grading 2. The analysis of the children's ideas also revealed that the children created the second most ideas during the card sort task with 31 ideas in total classified as unique with grading 2.

With basis in the age groups, table 2, 3 and 4, the analysis show that the nine and eleven-year-olds still generated the most ideas classified with grading 2 in the first task, namely 18 and 17, respectively. The children of hospital employees generated the most ideas classified with grading 2 in the third session, the card sort, with 10 ideas.

Inconsistency

My analysis shows that in total, 110 ideas were classified as inconsistent with the usability criteria, see table 12. This makes up for about half of the total amount of unique ideas.

Content is one of the categories with a majority of inconsistent ideas compared with consistent ideas. In this category, 50 ideas out of a total of 83 were inconsistent with the usability criteria, see table 12. The classification in this category was illustrated with many various courses to complete. This idea goes partially counter guideline number 41: "*Do not use more than two navigation levels or schemes*" [19]. Another idea in the main category content is category names like "*something that bothers you*" or "*negativity*". These ideas go partially counter to guideline number 39: "*Create meaningful category names*". The last idea involved scrolling and goes counter to the guideline number 3: "*Design for no scrolling*".

Further, my analysis reveal that ideas classified in the category media, are the least inconsistent with 13 unique ideas out of a total of 38, see table 12. This classification is illustrated with ideas such as to shot emotions from one place to another and spaceship storms across the screen with fire, smoke and sound effects. These media ideas go both partially counter to 2 guidelines. The ideas go partially counter guideline 23: " *Make sure that the animation does not interfere with the element's functionality*". The second guideline is number 31: "*Do not disrupt users with sudden loud sounds or music*".

The analysis shows that the rest of the categories have about an equal amount of ideas classified as inconsistent compared with consistent. Help features include choice of helper that all the users might not relate to, like mermaids. This idea goes partially counter with guideline is number 68: "*Design characters that kids can identify with*". Another idea in the help features category is text-based explanations and goes partially counter with guideline number 21: "*Help inexperienced readers by supplementing text with other kinds of explanation*". The same idea also goes counter with guideline is number 15: "*Use easily understandable and succinct text only. Minimize the amount of text on screens*".

[19] See Appendix D for references for the guidelines by Nielsen Norman Group

In the category interaction, an idea such as to hit a body part with a car to indicate that the user's body hurts there, see Fig. 24. The picture shows a racecourse with body parts. The user can hit the body parts with the car to indicate pain on the body part in real life. This idea goes partially counter to 2 guidelines. The first guideline is number 4: "*Use standard interaction schemes. Use well-known navigation and interaction methods that are common"* [20]. The ideas go also partially counter to components in guideline 23: " *Make sure that the animation does not interfere with the element's functionality*".

Further, items that creates ambiguous symbolisms such as a roller coaster, which the children interpreted as scared or stomach problems were suggested. This idea go counter to one guideline, namely number 11: "*Use icons and symbols in familiar ways*".

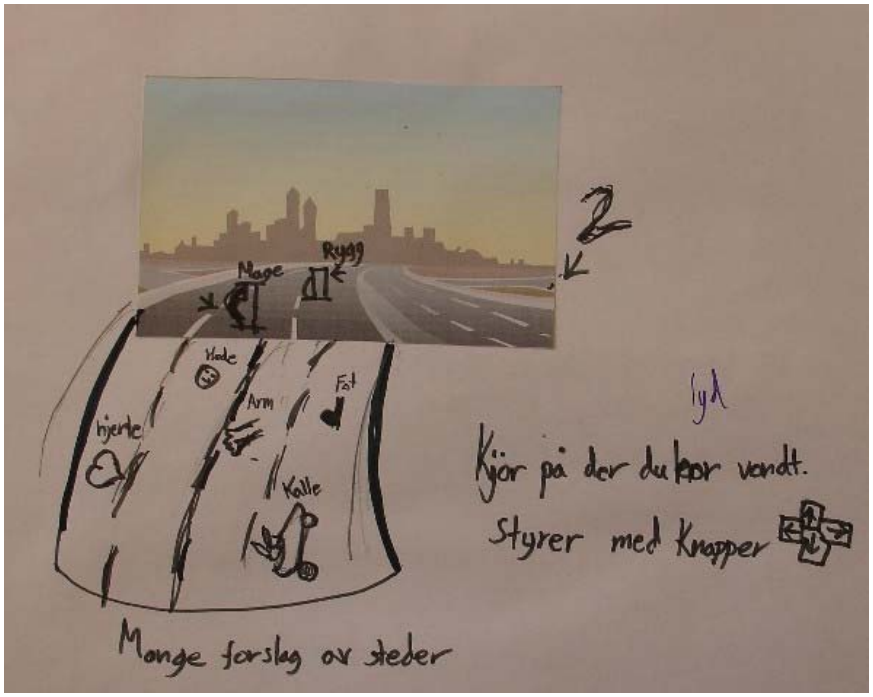


Figure 23: One idea classified in the main category interaction was based on the concept of a racecourse with hitting body parts with a car to indicate pain in the chosen body part (SPS, 2005).

The ideas classified in the experience category included "*click twice on something were the second click deactivates the first click*". This idea goes partially counter guideline number 4: "*Use standard interaction schemes*".

[20] See Appendix D for references for the guidelines by Nielsen Norman Group

Example of an idea classified in the input category was to shoot vomit on buttons. This idea partially counters two guidelines. The first is number 37: "*Use standard navigation and search schemes*". The second guideline the ideas go partially counter is number 42: "*Do not design interface elements to have more than one intended function*". Another idea classified in the input category was to choose super hero avatars like Spider-man or Superman that all the children may not relate to. This idea partially counter guideline is number 68: "*Design characters that kids can identify with*".

Generation of most inconsistent ideas in task

My analysis shows that when the children were asked to create their own version of the system in session 1, they created the most ideas classified with grading 1 and 0, see table 1. In total 35 ideas were classified as inconsistent with Gilutz, Nielsen (2002) and Hanna's (1999) guideline in contrast with 42 ideas that were classified as consistent compared with the same criteria. The analysis also showed that the children created 30 unique ideas classified with grading 1 in the card sort task. Both session 1 and 3 had the most children participating.

When looking at the age groups separately, see tables 2, 3, 4, both the nine and eleven-year-olds created the most ideas classified with grading 1 in the last task, 12 and 15, respectively. The nine and eleven-year-olds also created ideas classified with grading 0, in the second and first task, respectively. The children of hospital employees generated the most ideas classified with grading 1 in the first task, with 21 ideas.

Ideas Consistent With Usability Criteria But Not PedsCHOICE

Ideas that were consistent with the usability criteria but not the PedsCHOICE project are presented in table 14.

Table 13: Overview of the number of ideas from all the ages and all the sessions that were consistent with the Nielsen Norman Group (2002) and Hanna's (1999) guidelines, but were inconsistent with the project's specifications.

Task	Consistent Ideas inconsistent with the PedsCHOICE criteria
Draw/create suggestions for the system	2
Continue to draw/create suggestions for the system	0
Card sort	2
Try CHOICE and comments on drawings	1
Totals:	5

In total the children suggested 5 ideas that were consistent with the Nielsen Norman Group (2002) and Hanna's (1999) guidelines but countered the project specifications for PedsCHOICE, see table 13. This project has specific criteria for what the system can and cannot have [21]. Therefore even if an idea is classified with grading 2, it may not be suitable for PedsCHOICE.

One idea that was classified as counter to the PedsCHOICE project was a nine-year-old girl's suggestion: "*you can name your own character by typing in the name*". This idea is not well suited in the PedsCHOICE context because, firstly, not all the users for this system can read and write. This is due to the reason that the users of the system are children in the ages of 7 to 12 and some of them are beginning to read and write. And secondly, the equipment for making it possible, i.e. keyboard or mouse, may be difficult to use with an intravenous inserted.

[21] See page 11 for a more detailed description of the PedsCHOICE specifications.

Discussion

In this chapter I will present my discussion. My aim for this thesis is to explore usability and my research questions had an overall question and two sub questions. With the overall research question being what types of ideas children generate in PD sessions, the sub questions were focused on in which PD tasks do children generate the most ideas and how many ideas fall into each usability criteria categories. The last sub question was divided into four smaller questions. The first one was focused around whether ideas were consistent or inconsistent with usability criteria guidelines. The second and third question dealt with which task did children generate the most ideas that were consistent or inconsistent with the usability guidelines. The last question focuses on ideas that were consistent with the usability criteria but incongruent with the project specification. I will answer these research questions based on my results.

First, the various types of ideas will be discussed together with the task that generated the most ideas. Further, I will discuss the consistent and inconsistent ideas compared to Nielsen (2002) and Hanna's (1999) usability criteria, along with consistency and inconsistence by task. Then, I will discuss ideas that were consistent with the usability criteria proposed by the Nielsen Norman Group and Hanna, but were inconsistent with the PedsCHOICE specifications. Lastly, I will discuss the involvement of the children in the PedsCHOICE project.

My first research question was what were the types of ideas children generate in PD sessions. My results show that the children contributed with many creative ideas. In total they generated 108 unique[22] ideas with grading 2, 105 unique ideas with grading 1 and 5 unique ideas with grading 0.

There are several aspects that might have affected the generation of ideas and types of ideas. The first aspect is the teamwork between the children. Scaife and Rogers (1999) have argued that children working in pairs are an efficient way to generate interaction and thus ideas and suggestions. Druin have found that children working alone are not productive in a

[22] When ideas are referred to as unique in the discussion, it means that the ideas can be coded into several categories, but an idea will remain unique within each sub category.

collaborative setting (1999a). In this project, the children worked in groups consisted of three children, two children and one child working alone. This counters the recommendations of Scaife and Rogers (1999). One disadvantage of working alone is that the children have no one to get inspiration from or discuss a suggestion with. This may lead to fewer generated ideas. Another disadvantage is that they may have ideas, but no one to tell them to. Therefore, the observers and the camera recordings will not capture their ideas. The children who worked alone were one nine-year-old girl and all the three eleven-year-old boys. The boys did fairly well with the amount of work and the ideas they created. But the nine-year-old girl did not generate the same amount of ideas. Both Scaife and Rogers (ibid) and Druin (1999a) have found that children working alone do not create the same amount of ideas as children working in pairs.

Second, my findings showed differences in terms of age. The eleven-year-olds were to some extent concerned of making ideas that could be perceived as childish. This was evident when they were presented with low-tech prototypes. All the eleven-year-olds wanted real life graphics, as emphasized by an eleven-year-old girl: "*It needs more details, not just a body with head and legs and stuff, but more real, more details*". The nine-year-olds' ideas did not have such a big difference compared to the eleven-year-olds. But they had to some extent problems with creating ideas that also would apply for older children. In general their ideas and suggestion were of a simpler kind than the eleven-year-olds. For example if the nine-year-olds suggested that the user could choose an avatar, the eleven-year-olds suggested that the user could make their own detailed avatar. The reason for the simpler ideas may be that the nine-year-olds may not have the same experience with computer use as the eleven-year-olds. My outcomes also showed that there were differences between the children of hospital employees within this group. The boys, age 8, were very often in "game mode" and created a system based on various game aspects like completing various courses in a fast manner, manage difficult challenges and shoot and hit items to answer questions. There is a possibility that games are more closely to these eight-year-old boys' computer experience that other applications and therefore might use this experience to create low-tech prototypes. Many of the children used metaphors with varying degrees in their systems, but the ten-year-old girls were more conscious about this and created entire sections of their systems as metaphors. They used a tree to describe various emotions and each branch on the tree symbolized different feelings.

Some of the children used in this project were older than what Druin recommends (1999a). She and her colleagues' findings show that the children should be between 7 and 10 years. Children in this age are the most effective design partners. The children for this project were in the ages 8 to 11 years old. They created many ideas and gave their opinions. However, some of the eleven-year-olds had the tendency to limit themselves by not creating ideas that may have been perceived as childish. The eleven-year-olds are close to being teenagers, and it is natural that they do not want to be associated with something that can appear childish. Consistent with Druin's findings (ibid), the eleven-year-olds were also to some degree preconceived of how things "were supposed to be". On the other hand since PedsCHOICE users are going to be children in the ages 11 and 12, they might want it to be close to the real world and how it is supposed to be.

Third aspect concerns the screening process of the children. When comparing the contribution of the nine-year-olds to the eleven-year-olds, my findings revealed to some degree differences in the results. The most distinct difference was in the total amount of generated ideas regardless of grading. The nine and eleven-year-olds created more ideas than the children of hospital employees. Further, my results show that the amount of ideas classified with grading 2 is relatively equal between these two age groups. The children of hospital employees, however, created less ideas classified with grading 2 than the nine and eleven-year-olds.

My results show that the children of hospital employees created to some degree equal amount of ideas classified with grading 1 as the 12 school children. Even though these children were only 4, the average ideas created by each child in this group were higher, compared with the two other groups, see table 2. Furthermore, the average ideas created in total for the children of hospital employees were just as high as the other 12 children's total average. However, the highest deviation between the three groups is if their ideas are consistent or inconsistent with usability guidelines; grading 2 on one hand and grading 1 and 0 on the other. Both the nine and eleven-year-olds created more ideas classified with grading 2 than ideas classified with grading 1 and 0. But the children of hospital employees, however, created more ideas classified with grading 1 than ideas with grading 2. Even though they were fewer children in the latter group it does not explain why they did not have a majority of ideas with grading 2 like the other children.

Hanna et al. (1997) argues that it is in general not a good idea to use children of colleague's as usability participants since they may have more knowledge about their parents work. In this project it may seem that the children of hospital employees did not have more knowledge about their parents work. Even though they created on average just as many ideas as the other children, they created almost twice as many ideas classified as inconsistent than consistent. Possible reasons for this could be the process of selecting the children for the sessions. The 12 schoolchildren were selected based on certain criteria, such as computer use, creativeness and motive for participating. These children used a computer on a daily and weekly basis (Vatne, 2005a). This screening process did not apply to the children of hospital employees. They were not screened at all, but may have been chosen because the children could easily be included into the project since their parents work at Rikshospitalet - Radiumhospitalet HF. There is no certain answer to why these 4 children created more inconsistent ideas than consistent it would therefore be of interest to compare the children's ideas with other usability guidelines than the one's used in my analysis.

The specification of this project emphasizes that PedsCHOICE is not a game, hence the fun and entertaining aspects have been toned down [23]. This aspect counters with the children's ideas. Even though the children were continuously informed that the system was not a game, the young participants had the tendency to be in "game-mode". My results illustrates that the children created ideas that involved fun and entertaining elements. An example of this was to hit a button with vomit, supplemented with both sound effects and animation. My result is not unique but is consistent with Scaife and Rogers' findings regarding focus on fun aspects in a system (1999), like in the ECOi Project where the children wanted dripping blood and burping sounds to illustrate the animals in a food web.

One interesting observation, however, was that the eleven-year-old boys were very focused with creating action driven systems with many entertaining aspects. But when they gained a deeper understanding of how it feels to be sick at a hospital in the fourth session, one boy said:

"If you're really nauseas, you're hardly able to do anything."

[23] See page 11 for a description of the project specifications

while another eleven-year-old boy said:

"If I'm sick it's OK by me to use CHOICE. If I'm really sick I don't wanna do anything. But if I'm a little sick, it's OK to use CHOICE"

This shows that when they are in the hospital setting, these two boys find the adult version satisfactory to use. For them it didn't matter if the adult version was free of colors, graphics or details, which made it boring according to the other children. It seems like when the children contributed in the first three sessions they were more focused on general fun ideas and inspired by computer games. But when the children were placed in a hospital setting it became more real and concrete to the children. When they were in this setting, which was relevant to the application area, the children became more serious. The children's change of comprehension of the system and setting, may show that role-play can be important to make the children understand what a system is intended to do. Another aspect is that the hospital setting may have been more concrete for the children to understand. Just as the paper prototypes may be more concrete than high tech prototypes (Scaife et al., 1997), the hospital setting may have been more concrete than testing various software. One factor that could have helped the children understand the purpose of the system was to have the children as design partners.

My results confirm Druin's (1999c) findings regarding the role children have in the design process and the level of contribution. The 16 children generated many great and creative ideas. These ideas helped the design team to generate new ideas based on the children's suggestions and to think in other directions than previously done. The contributing children in this project had the role of user, tester and informant. But they were not equal design partners as Druin (1999a) describes it. She argues of viewing the designers and users as equals. Systems development for seriously sick children requires psychological and pedagogical aspects (Ruland et al., 2005) and therefore the research group at SPS did not include the children in every aspect of the project. PD emphasizes that user participation is important and that there is a need for mutual learning and view the designers and users as equals. By including the users to participate, both can make decisions. For the PedsCHOICE project, the children were asked to contribute to the project when the researchers believed that they could inform or add something new to the design process. The children did not have the opportunity to change the agenda for the sessions. The decision of choosing ideas was not democratic due

to the reason that the children did not have the opportunity to decide what ideas were feasible or not.

My second research question was which PD tasks the children generated the most ideas. I have showed that most ideas, regardless of grading, were generated during the first session where the task was to make their own version of the system. This session provided the children with various materials such as paper, glue, clipart etc. that the children could use as they wanted. There is a possibility that the children are more familiar with this kind of materials and task, than the tasks presented to them in the other sessions. It may also be that this task was more concrete for them. The finding of Scaife et al. (1997) show that children comment more on low tech prototypes than high tech ones. Druin is aware of at least one difficulty of including children in the design process. And this is the children's ability to verbalize their thoughts, especially when dealing with abstract concepts (Druin, 2002 in Nesset and Large, 2004). Paper prototypes could be more concrete which makes it easier for the children to verbalize their thoughts and suggestions.

My analysis shows that the nine-year-olds created the highest number of ideas in the first task, followed by the third task, the card sort. In the card sort session the children were given various words and symptoms to categories, as they wanted. The eleven-year-olds created most ideas during the first task as well, but generated the second most amounts of ideas during session 2, the continued work from the first task. The children of hospital employees generated most ideas during the card sort. My results are not distinctive, but in consistency with Hanna and her colleagues' (1999) recommendation of choice of tasks given to children. Based on my results, there is a relationship between ideas and tasks. And, as my results confirm, some tasks created more ideas than others. Paper prototyping and card sort are amongst the tasks argued to use by Hanna and I have shown that, in this study, the same tasks have created the most ideas. Low-tech prototypes may be better for children to deal with than high tech prototypes. This is consistent with Scaife et al. (1997) findings that users, including children, are more likely to be more critical to paper prototypes than a piece of software. On a more general level, Wong (1992 in Scaife et al.,1997) found that the users gave more feedback when dealing with low-tech prototypes than finished interfaces.

One of my research questions was to find out how many ideas fall into each usability criteria categories. My results show that the categorized ideas did not have an even distribution in the

usability categories. Some main categories had a higher occurrence of ideas than others. Of all the ideas overall, regardless of grading, some main categories stands out with high occurrences of ideas. The main category content has the highest occurrence of ideas. Other main categories with high occurrences are media, interaction and input. All the main categories contained both ideas classified as consistent and inconsistent. Consistent ideas classified in main categories like media, interaction and input had a higher occurrence than other consistent ideas in the remaining categories. My outcomes also show that inconsistent ideas classified in main categories like media, content and interaction had a higher occurrence than other inconsistent ideas in the remaining categories.

Another research question was to compare the suggested ideas with Nielsen Norman Group (2002) and Hanna's (1999) usability criteria. My analysis shows that half of all the ideas were classified as consistent with usability criteria from Gilutz, Nielsen (2002) and Hanna (1999) and the remaining half were classified as inconsistent. My findings show that the most consistent usability criteria concerns media, where over half of the proposed ideas were classified as consistent. The children might use their experience from other multimedia sources such as computer games and the Internet. With a relatively high amount of consistency in some categories, like media, it is interesting to think about if the children have an intuitive sense of what is usable or "right" in a system. Swartout and van Lent (2003) argue that design of computer games are focused around the user's experience. This may show that the children to some degree have an intuitive sense of what is usably on a system. Some of the contributing children's ideas are based on their experience with computer games, Microsoft applications, and the Internet (Vatne, 2005a). Sometimes these ideas may be usable and sometimes they are not so usable. The research of Fisch (2004) argues that visual action and identifiable characters appeals to children in interactive software. These aspects seem to be appealing for the contributed children in the PedsCHOICE project. My findings show that they created many ideas involving visual action and various characters. Swartout and van Lent (2003) also argue that usability is central in interactive media such as computer games, because this software is voluntary, thus the usability should not affect the use. The aspect of voluntary use counters the PedsCHOICE project. The PedsCHOICE is not a game that the children can use whenever they are bored. It is a symptom assessment tool for pediatric cancer patients. The children will use it to help clinicians give a more personalized treatment.

I have showed that the content is the most inconsistent usability criteria; over half of the ideas were classified as inconsistent. These ideas were for example vague category names, scrolling, too many navigation levels, and not too clear tracking mechanisms. It is an interesting result that the most inconsistent ideas are in the main category content. There is nothing that indicates why exactly this category was the one with the most inconsistent ideas. It might be a possibility that the children tried to be overly creative. To find the answer to why this category was the one with the most inconsistent ideas, more research needs to be conducted where the ideas could be compared with other usability criteria than the ones used in my analysis.

Furthermore, the most inconsistent task regardless of grading, were the creation of low-tech prototypes task given during the first session with 36 (35+1) unique ideas. In the continuation of the first task, during session 2, the inconsistent ideas decreased to 16 (13+4), for the third task the card sort the inconsistent ideas increased again to 30 and lastly the decreased again for the fourth session with 27 unique ideas.

Another research question dealt with which task the children generated the most ideas that were consistent with the usability guidelines. I have showed that the task that generated the most consistent ideas overall, is the paper prototyping task given during the first session created 42 ideas. When the task from session 1 continued in session 2, the number of ideas decreased to 21 ideas. The number of consistent ideas increased again for the third session with 31 ideas, and decreased again for the last session with 14 ideas. Session 1 and 3 were the only session with 16 children participating, the other session had 12 children contributing. The results for the task that created the most consistent ideas and the results for the task that created the most ideas overall are similar. And also consistent with the recommended tasks, paper prototypes and card sort, by Hanna (1999) when involving children in the design process. Paper prototyping seem to be a task that makes the children generate many ideas. There is a possibility that this task is an activity that the children grasp quickly, gets them engaged and is more concrete than other activities. They may also have previous experience with working with the materials, like paper, pens, clay and glue at school and that they are familiar with this kind of work.

When the task are broken down by age, my results illustrates that the nine-year-olds had the most consistent ideas during creation of low-tech prototypes, session 1, followed by the card

sort, session 3. The eleven-year-olds, on the other hand, produced the most consistent ideas during the first task, just as the nine-year-olds did. But the second most productive task for the eleven-year-olds was during the second session with the continuation of the work started the previous session. The children of hospital employees produced the most consistent ideas during the third session, the card sort. The least productive task for these particular children was the first task with creation of the low-tech prototype.

There is one deviation compared to the recommended tasks by Hanna. The least productive task for the eleven-year-olds were the card sorting. Not all the children are going to behave exactly the same or be able to create the most ideas where it is expected. Hanna's suggestions for tasks are recommendation and do not guarantee that the children will produce ideas according to these recommendations.

One of my research questions was to find out which task children generated the most ideas that were inconsistent with the usability guidelines. The results regarding the task that generation the most inconsistent ideas are quite similar with the results from creation of most consistent ideas in a task. Both have the first session as the most productive one, followed by the third session. The third most productive task for inconsistent ideas was the task with commenting on drawings and testing of CHOICE. And the least productive task for generation of inconsistent ideas was the continuation of the work started in the first session.

When looking at the age groups separately, my results show that the nine-year-olds generated the most inconsistent ideas when they gave feedback and tried the CHOICE device during session 4, followed by the second session with the continuation of the work started in the first session. Then, card sort in session 3 and lastly the creation of the paper prototypes created the least inconsistent ideas. The eleven-year-olds also had the most inconsistent ideas in the fourth session when they tried CHOICE and commented on drawings, followed by the card sort in the third session and. Then the continuous work with the paper prototype in the second session. Lastly, the creation of the paper prototypes in the first session created the least inconsistent ideas. The children of hospital employees crated the most inconsistent ideas in the first task with creation of paper prototypes, followed by the card sort in the third task.

My last research question was to uncover ideas the where consistent with the usability criteria but incongruent with the project specification. My analysis shows that of the ideas classified

with grading 2, 5 ideas were incongruent with the project specifications. The guidelines discusses usability in general and the PedsCHOICE project has it is own specifications that needs to be considered, and therefore limits the guidelines. The specifications are necessary to make system that is usable for the end users.

In this thesis, I have used the usability guidelines proposed by the Nielsen Norman Group (2002) and one guideline suggested by Hanna (1999). Hanna's guidelines are more general than the ones proposed by Gilutz and Nielsen. The guidelines for these two research groups overlap a great deal with each other. The only additional guideline from Hanna is reward, which was included as a sub category in the main category content.

The PedsCHOICE project will be used on a handheld device while guidelines of Gilutz and Nielsen (2002) are based on websites. Well designed websites and software can have several aspects in common, but for my thesis usability has been of interest. Usability for websites and PedsCHOICE has similarities. For example, both should support the children with easy and accessible help section supported by other media than just text, like audio and animation. The navigation should be easy and intuitive to understand. The content should reflect the children's age with the right level of understandability and readability. Icons and symbols should be used in familiar manners. The children should be able to relate to avatars and characters. Another similarity is that the users are children. The guidelines have been described and discussed. Not all of the usability guidelines have been relevant for this project, but those that I have used were also general enough to be used in my thesis.

The guidelines proposed by the Nielsen Norman Group (2002) and Hanna (1999) are not to be considered as a solution to all matters regarding usability. The usability criteria are recommendations and suggestions only. These guidelines may not fit all websites or systems. There is also a possibility that the reason for half of the ideas are inconsistent compared with these guidelines, are that they are not sufficient to use for this project. One possible way to investigate this would be to use other guidelines to grade the ideas and see if the outcome was similar. Since this has not been done, I can only base my assumptions on my results. These results show that half of the ideas match and the other half match in various degrees or not at all. This may show that these usability criteria can be applied in projects concerning usability for children. On the other hand, other guidelines might give a different result with a

possibility of a better result, i.e. more ideas classified with grading 2, than achieved in this thesis.

Druin and Nielsen have different opinions regarding children's ability to overcome usability problems (Nesset and Large, 2004). They agree that it is advisable to include children in the design process. But Nielsen argues that the children are incapable of overcoming many usability problems because their impatience prevents them from making suggestions for improvement. This is more relevant in the Web environment. Druin focuses on software development with children as designers and may have different experiences than Nielsen.

There is a possibility that the different focus on software and websites might be seen in relation to the amount of inconsistent ideas.

It is interesting to think about if they were given a chance to be equal partners, would they be able to complete the task? Would they be able to decide which ideas would fit the PedsCHOICE project, given the criteria for the project? It might have been possible that the children could have been more than informants in this project. They could have been involved in the note taking during the sessions. They would probably not be able to take notes as adults with text, but notes in the sense of drawing or cartoon-like sketches. I also think that the children might have been used as facilitators during session 1 and 4 when various software was tested. This has been done in Druin's (1999b) research where the children both took notes and were facilitators for the other children when new software was presented. For the PedsCHOICE project there are psychological and pedagogical aspects that needs to be taken into consideration. To some degree a few children did understood these aspects or the purpose of the system. This was especially evident in the pilot and the first sessions for the 12 school children. Their ideas were very inspired by games and they used the word play, such as *if you have been to the same level before, you can create a new username and play the same level one more time"* and "*we used levels so that we can get more challenges"*. After more sessions were conducted the children gained more knowledge of the purpose of the system. This was to some degree apparent in the last session, which the children were in hospital beds and testing CHOICE, the symptom assessment tool for adult cancer patients. The comment by the eleven-year-old boy regarding the use of CHOICE if he was sick makes the thought of including the children further in the design process more appealing. Children are able to be equal design partners as various researches of Druin and her colleagues (1999a) show. They

have included children as equal design partners and have together with the children taken decisions and made prototypes.

One aspect that could have been a factor to the contribution of ideas from the children is the level of comfort with themselves and the environment. It is possible that the video recordings during the session affected the children is such a way that they did not feel comfortable suggesting ideas. This may have been most evident in the first sessions when the children were quiet and shy. An additional factor when using a video camera is when the children are working alone, the video camera will not be able to record their ideas. Even though all the children presented their work at the end of the sessions, some of the children were not as talkative as others. Another factor that could have contributed to the comfort level was the number of adults present at the sessions. In the first sessions the number of adults exceeded the number of children. Even though the number of adults decreased for the other sessions, the number of adults and the number of participating children were about the same.

The average for generation of ideas for each child throughout the project may reveal how comfortable the children were during the sessions. If they were not comfortable in the first sessions, the average might be lower than in the last session, for example. The children of hospital employees had the highest average in the first session. The average for the next session declined. The nine-year-olds had the highest average in the first session and the least ideas per child in average in the last session. The total ideas in average are similar between the children of hospital employees and the nine-year-olds. The eleven-year-olds had the highest average in the first and last session. In total, the eleven-year-olds had a higher average per child than the other children. Based on the average ideas created by each child, it may seem like the children were comfortable during the first sessions. I was present at several of these sessions and I saw that some of the children were not as comfortable as the average may express.

For this project the adults were not equal partners to the children during the sessions. The adults did not cooperate with the children with the generation of ideas. The adults were instead observers and facilitators. The children were told that the adults could help them if they needed it, but they rarely used this offer. When the children did use the offer, it did not influence the work of the children. One exception was an eleven-year-old boy who started to work with one of the adults during the second session. Their suggestions included some of the

ideas that were classified with grading 2 such as assistance for younger children who cannot read. If the cooperation between the children and the adults would have been better, it is possible that the children would have understood more of the purpose of the system, and able to be more equal partners than they were during the sessions.

In retrospect it is a possibility that the order of the sessions could have been rearranged by having the last session as one of the first, such as session number one or two. This could have aided the understanding of the purpose of the system for the children. And in combination with more involvement by the adults during the sessions, could have made the children more than informers. The comments by the eleven-year-old boys regarding use of CHOICE if they were sick shows that they are able to some degree identify with the sick children.

Conclusion

What can be concluded from my thesis is that the 16 children, in the ages of 8 to 11 involved in the PedsCHOICE project contributed considerably. The children generated creative comments, feedback, low-tech prototypes and suggestions and these ideas gave the designers inspiration and different perspectives on the systems development.

To make the children create ideas, sessions were conducted, during which the children were given various PD tasks to solve. This proved to be successful to include the children in the design process. The children were divided in three groups, two of which were divided according to age and the last where a mixed group for pilot testing. All the children were given the same task, an exception was the children in the pilot testing group that conducted 2 of the 4 sessions; session 1 and 3. One outcome of my project shows that there is a relationship between ideas and tasks; some task creates more ideas than others. A reason for this could be that some tasks are more concrete than others. One of the tasks is the creation of paper prototypes. The children used various materials like paper, glue, clipart etc. available and made their own versions of the system; they used material that they are familiar with and the task was very concrete. Another task, which also generated many ideas, was the card sort. In this task the children were asked to sort different words, to ensure that certain categories for a system are in accordance with children's exceptions. The children's ideas suggested in relation to the paper prototypes and card sorts gave the researchers both usable and not so usable ideas.

Several aspects can affect the generation of ideas in sessions. First, some children worked alone. The sessions were videotaped whereby it became difficult to capture their ideas when they did not have another person to discuss their suggestions with. Therefore, it might have been more useful if the children were asked to work with each other. Another aspect is the screening process. The participants for the sessions should go through the same screening process, based on certain criteria. This process may vary depending on the aim of the sessions. In this project 4 contributing children did not go through any screening process, while 12 children did. These 4 children created less usable ideas compared to the other children.

Children involved in design processes create many ideas and it can be difficult to choose ideas that are usable, therefore it may be helpful to use some kind of guidelines or grading to classify and compare the ideas with. By classifying the ideas in categories and grades, revealed that half of ideas proposed by the children, in this project, were consistent with the guidelines that were used in the comparison. The children have better intuitiveness regarding certain usability criteria than others. The children are able to use their experience from computer games, the Internet, and various software when they create ideas. By having the children inspired by already existing software may increase the usability aspect and several children created ideas involving metaphors. The paper prototype was the task that created both the most consistent and inconsistent ideas. This shows that the creation of ideas is related to what kind of tasks the children are involved in. The created ideas are both usable and unusable.

Even though ideas are usable compared to guidelines, they may not be consistent with the project specifications. In this project, some ideas were usable according to the usability criteria, but were inconsistent with the project specification. Every project is unique and has its own requirements; this makes some of the usable ideas not appropriate. In this project the prospective users are children with cancer, hence there are particular aspects that needs to be taken into consideration that sometimes contradict usability guidelines.

In participatory design projects children can be involved as users, testers, informants, and designers. In the PedsCHOICE project the children had the role as users, testers and informants. Designers can include the children as design partners in order to create an equal relationship. However, not every child is able to have this role, but a few children in this project expressed opinions that might have made it possible for them to contribute more than just as informers.

In a more general aspect, it is helpful to include the users when a new system is to be designed. Participatory design can contribute with mutual learning where the users and the developers learn from each other. Mutual learning is an efficient way both for developers and for users to gain knowledge. The developers learn about the users' work environment while the users learn about the technological options. This will increase the possibility that the system will reflect the users' needs, thus increases the possibility that the users will use the

software. Nevertheless when children (users) are to select for participation, they should be chosen based on the similar criteria. This will probably increase consistency of the results. Various methods can be used to include the users in the design process. One is to arrange workshops or activities, where the users and the developers can work together and generate possible suggestions for the software to be designed. The children were very creative and generated many various ideas. It is important that the tasks given to children are concrete, such as creation of paper prototypes. This will most likely increase the amount of generated ideas. This study shows that participating children can have the role of user, tester, informants and design partner.

An ideal situation is when the users and the developers work together as equal design partners. But the users can be included in various degrees depending on how much input the developers want from the users. The workshops or sessions can be documented by, observations and video recordings. If these are used it is important to have the users, especially if the users are young, i.e. children, to work in pairs. This will increase the possibility of capturing the users' ideas, since the camera can only record what is being said and done. The users create numerous ideas that have to be assessed by the developers. Guidelines can be helpful for the developers to decide whether or not an idea should be used.

Future Research

The PedsCHOICE project is an ongoing project and is in the prototyping and testing phase. The system is not yet released or in use at the Rikshospitalet - Radiumhospitalet HF. The project involves many aspects and has potentially various future research projects regarding treatment by clinicians, design, prototyping, psychological effects, pedagogical effects, and the use of the handheld device. When it comes to the usability aspect of the project, it can be interesting to see if the end users, children with cancer, find the finished system usable. And if some of the 16 participating children's ideas are included in the finished version, it can be interesting to explore if the hospitalized children find them useable as well.

It is also be interesting to get the opportunity to be a part of other projects involving design with and for children, especially with focus on usability. By using the experience I've gotten with the work for this thesis I would be able explore their ideas and possibly compare them

with the result of this thesis. It would be interesting to see if the level of usability would be same or if it would be different. It may also be interesting to see if other PD tasks could create the same amount of ideas.

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Appendix A

Scenario from the first sessions, (Vatne, 2005b).

Dette er ... han/hun er … år. I dag er det… dag og … er på vei til skolen. Skole veien er lang, Han/hun går oppover og nedover bakkene og blir veldig **sliten i bena**.

I dag er det også ganske **kjedelig** å gå til skolen for … er syk. … er bestevennen til... Nå føler … seg ganske **alene**.

Vanligvis har … det gøy på skolen men ikke i dag. … pleier alltid være sammen med … i friminuttene og han/hun **vil liksom ikke leke med andre barn** enn han/hun i dag. Han/hun har faktisk litt **vondt i hodet** og blir så **fort sliten og orker ikke noen ting.**

Heldigvis har de bare 4 timer på skolen i dag og det er bra for … føler seg ganske dårlig. Når han/hun plutselig blir **kvalm** og får **vondt i magen** ringer læreren til foreldrene hans/hennes så de kan komme og hente han/henne.

….Blir **redd for å ha blitt smittet** av …….. Å nei tenker…..og vi som skulle på Tusenfryd i morgen! ....blir **redd** for at han/hun ikke kan være med. **Lei seg** blir han/hun også. Så typisk å bli syk akkurat i dag!

Den kvelden **får ikke ….sove.** Han/hun **klarer ikke slappe av.** Når han/hun til slutt sovner får han/hun **mareritt** om at alle andre har det gøy og er på tivoli, men ikke han/henne.

Dagen etter drar de til legen. Selv om ….. har **vondt i hodet** er han/hun sikker på at han/hun er frik nok til å dra på Tusenfryd. ….**gruer seg** litt til å dra til legen. Tenk hvis legen sier at han/hun må ligge hjemme i senga. Han/hun er så spent at han/hun **skjelver på hendene**.

Legen gjør mange rare ting og så snakker han masse til pappa. De voksne sier mange rare ord som …..ikke skjønner. …..Vil gjerne fortelle at han/hun ikke føler seg så dårlig og sikkert er frisk nok til å dra på Tusenfryd, men de voksne hører ikke på han/henne.

…..blir **sint,** fryktelig sint!! Hvordan skal han/hun få fortalt hvordan han/hun har det. da kommer det en sykepleier inn på kontoret. I hendene holder hun en liten datamaskin. Denne kan du bruke sier hun. Trykk på denne og fortell hvordan du har der!!!

Hvordan ser dataen ut? Hva ser …..på skjermen? Nå kan dere hjelpe oss å finne på hva ….ser. dere kan bruke alt dere ser her for å lage eksempler.

Appendix B

Scenario from the second sessions (Vatne, 2005b).

Dette er historien om …… som er …..år. i dag er det…..dag og. ….. er ute med vennene …… og …….

Like ved der…..bor er det en idrettsplassmed en stor klatrevegg. Egentlig er det nok ikke lov til å klatre i den, men det er fryktelig spennende. …….og vennene sniker seg over gjerdet uten å bli sett. Det er superspennende.

…..Synes han/hun er ganske god til å klatre, kanskje bedre enn ….og ….. De finner ut at de skal lage konkurranse og den som klatrer høyest får 20 kroner av de andre. Hun/han klatrer høyere og høyere. ….. og ….. står nede på bakken og ser på.

Plutselig kommer det noen. …. Og …. Skvetter til og løper av gårde. …..blir så forskrekket at han/hun mister taket og faller rett i bakken. Så husker ikke….mer av det om skjedde. Det eneste han/hun vet er at han/hun våkner opp på sykehuset,

….er **svimme**l., supersvimmel og det gjør **vondt i hodet**. Det tar lang tid før han/hun skjønner at han/hun ligger i en seng på sykehuset. Du har fått hjernerystelse sier pappa. Du falt ned fra klatreveggen og ramlet rett på hodet, så nå må du være her på sykehuset en stund.

Å nei tenker ….. Så **flaut** så fryktelig fryktelig pinlig**. Det er min skyld** at jeg ligger her og er syk, jeg fikk jo egentlig ikke lov til å klatre. ….blir **lei seg og gråter.** Han/hun kryper inntil pappa og **oppfører seg som han/hun var mindre**. Det gjør **vondt andre steder** også, i armene og bena blant annet.

Han/hun løfter opp dyna og ser nedover seg selv i senga. Han /hun ser masse **sår** og masse **blåmerker på huden.** Når han/hun får se seg i speilet ser han/hun at han/hun **blør neseblod**

og er skikkelig oppskrubbet i ansiktet. ….kjenner seg selv nesten ikke igjen, han /hun **føler seg så annerledes** enn før.

….**lurer på hva som skal skje** på sykehuset, hva skal de gjøre med ham/henne?. Han/hun har hørt mange historier om vonde og skumle ting og blir ganske **redd**. Men når legen kommer inn for å undersøke **klarer han/hun ikke snakke.** Ordene sitter liksom fast i munnen, han/hun klarer ikke stille et eneste spørsmål og **får ikke vite det han/hun lurer på.**

……kunne trengt litt hjelp til å fortelle hva som plaget ham/henne og snakke med legen. En liten datamaskin kunne kanskje været tingen. På denne kunne han/hun fortalt at han/hun var svimmel, hadde vondt i hodet, var flau, lei seg og redd. Hadde vondt i kroppen, i armene og i bena, hadde sår på huden og blåmerker, at han/hun følte det var hans /hennes skyld og lurte på hva om kom til å skje på sykehuset.

Så hvordan kunne dette dataprogrammet være? Nå kan vi jobbe videre med det dere holdt på med forrige gang, eller dere kan lage nye ideer.

Appendix C

The list of predefined list of categories for the video analysis

- Navigation
- Input for information
    - Input for representation of one self LEG-E
- Wallpaper
- Help / support
- Experience of the system
- User variation
- Special effects
- Miscellaneous
- Irrelevant

Appendix D

Here is an overview of usability guidelines proposed by the Nielsen Norman Group (Gilutz and Nilesen 2002).

GENERAL INTERACTION

1. Buy common misspellings of your domain name. Pornography sites probably will, if you don't.
2. Adhere to the principles of good design. When designing for kids, follow the basic good design rules you use when designing for adults. A website does not have to be childish in order for kids to use it successfully.
3. Design for no scrolling. Fit information on a page viewed at 800 x 600 resolution.
4. Use standard interaction schemes. Use well-known navigation and interaction methods that are common on other websites or are ubiquitous in the physical world.
5. Use standardized forms. Design form structure and widgets in the most simple and standard way. Most kids on the Internet today have an understanding of basic Web concepts, such as filling out forms and using passwords.
6. Avoid members-only features. We found most kids aren't allowed to become members. Carefully consider whether to offer memberships on your site at all. If you do offer exclusive features, consider which information should be accessible for members only, because most of your audience may never see them.
7. Don't ask kids for personal information that can endanger their privacy on the Web. Encourage them to protect their personal information, for example: tell them to invent screen names. Instead of using their real names.
8. Create immediate success. Make it easy for kids to find what they want on their first attempt.
9. Make sure every feature is high quality and works well. It is better to have fewer features that all work perfectly, rather than include some that are mediocre or difficult to understand. Negative experiences cause users to form a bad impression of the entire website.
10. Provide explicit directions. Tell the user exactly what to do, right on the screen.
11. Use icons and symbols in familiar ways. Match icons. design to their meaning in the physical world.

TEXT

12. Use simple, relatively large fonts. Text fonts on screen should be comparable in size to at least 12-point print type (when viewed on the target audience's most common screen resolution). Provide good contrast between the text and the background. Contrast is especially important for beginning readers and those who are reading a second language.
13. Place text on solid backgrounds. Avoid putting text on background images, especially if they are dynamic.
14. Do not use animated text. Using animation or other special effects on text causes problems when it is too slow or too fast, or when objects and text are superimposed. If you must animate text, let users control the pace.
15. Use easily understandable and succinct text only. Minimize the amount of text on screens.
16. Maintain a consistent readability level. Make sure that text on all pages and activities consistently reflects users expectations and reading capabilities.
17. Distinguish and isolate content for adults. When content on a children's website is aimed at adults (and thus requires a different level of readability), design the interface so that young users will not accidentally encounter it.
18. State clearly to users that they have reached an adult section. Present a straightforward and easy way back to the kids content and activities.
19. Add short and unambiguous textual instructions and directions. About half of your users depend on text to explain the website's activities.
20. Provide instructions that are always accessible. Place easy-to-find links to brief text explanations wherever the user might need or want instructions.
21. Help inexperienced readers by supplementing text with other kinds of explanation. Don't rely solely on text when designing instructions for beginning readers and international users. You may provide directions using other media, such as diagrams, animation, and sound.

MULTIMEDIA

22. Design multimedia for your audience's connection speed. Research your potential users technical environment. Use animation in your design ONLY for users who have a high-speed Internet connection. Flash movies over a modem or similar connection

caused frustration that usually resulted in users skipping the animation or clicking the Back button.

23. Use motion and sound to attract kids attention and engage them. Kids find animation and sound extremely engaging. Use animation as a way to focus users attention on important elements on the screen. Make sure that the animation does not interfere with the element's functionality.
24. Show users the status of multimedia downloads and playtimes. Present progress to completion, how much time or file size remains for downloads, and how long it takes to play the actual multimedia clip. Tell the user about stalls or interruptions so they can make an informed decision about the rest of their session.
25. Allow the user to control the multimedia clip. Provide an explicit skip feature (such as a "skip" button) for all Flash movies. Use familiar keyboard controls (such as ESC) to allow the user to pause, skip and play the movie.
26. Make intro animations short and interesting. Animations that are short (10- 20 seconds) and meaningful (funny, surprising, intriguing, and so forth) work best. Boring intros or long waiting times can cost you your audience.
27. Use passive animation while downloading large game files. Add simple, fun animations to hold users attention while loading large files. Using interim interactive games for this purpose is not recommended. If you do use games, provide effective feedback to signal download completion.
28. Avoid automatic Flash replays. Avoid both re-downloading and re-running Flash movies that users have already seen or skipped (such as homepage interfaces or intro clips).
29. Provide non-multimedia content alternatives. Provide both a Flash and non-Flash entrance to the website or web page.
30. Use background music for ambience but give control to the users. Consider using background music when designing for kids, but give them an easy way to control volume or to stop the music at any time. Kids enjoy cheerful background music. But want the option to turn it off at any point.
31. Do not disrupt users with sudden loud sounds or music. Abrupt changes in the users. Environment can be jarring. Turn up sound gradually and allow immediate user control of mute and volume.
32. Make the audio visible. Add visual representation for the sound on your site. Users might be unaware that they need to turn their speakers on.

33. Use music that is popular and familiar to your target audience. Kids get excited when they hear music they know.
34. Use sound to supplement and enhance the interaction. Do not rely solely on audio rollovers and sound effects for important navigation. Adding audio rollovers provides an experience enhancement that kids enjoy, especially if the sounds are funny.
35. Consider using rollovers for narration. Add rollovers for audio narration and instructions if your target users are unable to read or are in the initial stages of reading. Record short (a few seconds) of clearly audible and understandable audio clips in age-appropriate language.
36. Don't depend on audio to explain navigation. Provide navigation that is independent of audio. The navigation structure and tools on the site need to be understandable to users without audio instructions. Often audio files download too slowly, and users make navigation decisions before hearing them.

NAVIGATION AND SEARCH

37. Use standard navigation and search schemes. Many kids are familiar with these conventions and use them easily.
38. Provide constant access to the search feature. Every content page should have a search box. Inside an activity, there should be at least a link to search available at all times, in a consistent location.
39. Create meaningful category names. Use informative titles for category names, rather than vague or trendy words.
40. Design search results to inform users about the website's content structure. Help users learn how to browse your site by showing the relevant content categories for each item in the search results page.
41. Do not use more than two navigation levels or schemes. Too many navigation systems in one website create confusion.
42. Do not design interface elements to have more than one intended function. Each interface element should have only one function, otherwise users get confused.
43. Present noticeable "you are here" feedback to users. Show users where they are in the website structure (homepage, category, activity), and where they can go. Make it easy to understand how to move around within the site.

44. Do not remove standard navigation tools from the browser window. Kids depend on these tools and get frustrated when they can't use them to control their web experience.

GRAPHICAL USER INTERFACE

45. Present the breadth of the website's content on the homepage, to achieve a true initial impression of what the site has to offer. The homepage should give an overview of the website without creating any false expectations.
46. Use precise and unequivocal labels. Define and distinguish interface objects by using concrete and plain language, so users can predict exactly what they will get by clicking them.
47. Make clickable items look clickable. Add visual affordances of clickability to interactive images and links. Make the distinction between clickable and non-clickable items clear.
48. Add simple visual rollovers to images that can be clicked. Graphic rollovers serve as cues to users that an item is clickable.
49. Design text buttons to look pushable. Make clickable objects three-dimensional, and use that visual cue consistently. Visual affordances that mimic real-world controls are extremely powerful with kids.
50. Beware of promotional elements that are too distracting. Users might never make it into your website.
51. Distinguish advertisements from content. Create a visual context for promotions and banners.
52. Mark the exits. Warn users when they are about to leave the site, and distinguish your content from others. Explain how to return to your website later.
53. Match advertisers closely with your site. Present only promotions relevant to the site's content and goals, because the ad's content will be perceived as the website's content.

SYSTEM ERRORS AND HELP

54. Integrate Help with the content. Most user assistance should be included in the main content of the page. Do not rely only on a separate Help section to inform users. Users sometimes search for information that is in a Help section, so make sure your site search also searches Help content.

55. Explain navigation schemes in the Help section. Help should not be only about content, because some users look in Help for assistance with using the website features.
56. Don’t assume users have any technical understanding. Don’t assume kids know subtle conventions, such as the difference between OK, Close and Cancel.
57. Minimize the potential for technical errors. Decrease the number of errors and error messages. Users lose patience and appreciation for the website when they experience errors.
58. Use terms that non-technical users understand. Kids do not understand technical terms such as plug-in names and connection speeds.
59. Do not offer to change the user’s settings permanently with dialog boxes, pop-ups, or alerts. Customization can undermine trust when it’s done without user understanding.
60. Design interactive dialog boxes so they will not be dismissed automatically. Examples: pop-up windows, error messages, download alerts, and customization alerts, which ask users to make a real choice, should be phrased in language and terms users understand.
61. Accommodate a low-tech audience. Do not use nonstandard or recently released features (such as plug-ins) in your design if your users probably don’t have the necessary software.
62. Automatically detect the presence or absence of plug-ins. When that is not possible, design the entry page so it will be easy for the user to understand which option they should click to continue.
63. Provide alternative content for users lacking necessary plug-ins. Add an explanation for users who do not have the necessary software and offer them alternative content.

CONTENT

64. Research your target users’ contemporary interests and match your website content to those interests. Present content that relates to the current trends in your users. age group generally, and aim for your target users’ interests specifically.
65. Address your users. age in a direct manner. Simply indicate which age group the site is for. For example, provide entrances (and features) for each age group, or explicitly state the targeted age group for your site. Use images, design and content that convey suitability to their age group.

66. Address users' intellectual curiosity with stimulating content. Play to users' curiosity and intelligence. Boost users' motivation to explore your website with sophisticated content. Kids look for interesting content and intriguing interactivity.
67. Keep content current. Users expect websites to be updated frequently, in terms of both content and design.
68. Design characters that kids can identify with. Kids are attracted to characters in general, especially when they are popular and funny.
69. Allow users to control or interact with characters. Kids enjoy the ability to influence various characters, and will seek out all the ways they can interact with them.
70. Have characters address the users directly. Allow characters to speak to users and create an opportunity for conversation.

Hanna's additional guideline regarding reward (1999)

Reward structures designed to motivate children to continue will need to address young children's problems with delayed gratification and self-monitoring. Older children (6 years and up) can be highly motivated by pointing systems and obtaining "high scores". However, younger children are often unable to track their own progress toward en goals unless they are given frequent reminders and intermittent rewards. Finally, humor in rewards should take into account the intellectual level of the children in the target age range.

Appendix E

The table gives an overview of unique ideas within task from each session. The 9 columns contain the following; the first column, session number, states which session it is, the second column, age, contains the age of the children participating in the particular sessions. Task, the third column, refers to the tasks given at the sessions. The three columns, unique ideas with grading 2, 1 and 0, respectively, refers to how many unique ideas were created during the tasks. The other three columns, total ideas with grading 2, 1 and 0, respectively, refers to how many ideas there are in total within each task.

Table 14: Overview of the tasks with corresponding occurrences of ideas.

			Occurrences of ideas					
			Grad 2		Grad 1		Grad 0	
Session	Age	Task	Unique	Total	Unique	Total	Unique	Total
1	8-10	Draw/ create suggestions for the system	7	15	21	23	0	0
2	9	Draw/ create suggestions for the system	18	21	5	6	0	0
3	11	Draw/ create suggestions for the system	17	26	9	9	1	1
4	9	Continue to draw/create suggestions for the system	9	13	6	5	4	4
5	11	Continue to draw/create suggestions for the system	12	18	7	7	0	0
6	9	Card sort	12	13	8	8	0	0
7	11	Card sort	9	12	11	11	0	0
8	8-10	Card sort	10	27	11	14	0	0
9	11	Try CHOICE and comments on drawings	11	12	15	19	0	0
10	9	Try CHOICE and comments on drawings	3	3	12	13	0	0
		Totals:	108	160	105	115	5	5